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A GREAT TRUST FOR ENGINEERING.

It is with unmitigated pleasure that we announce this week the news that carrying out and broadening plans to which he first gave publicity about a year ago, Mr. Andrew Carnegie has now taken the final steps to create a great trust for engineering in the hands of the three national engineering societies—the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers. Our readers will remember that at the outset Mr. Carnegie proposed to give $1,000,000 for the erection of a Union Engineering Building in New York City. Matters have now so shaped themselves that the original plans have necessarily undergone extension, so that the three societies find themselves trustees under Mr. Carnegie's gift of a sum of $1,500,000, to be administered by them for the promotion and benefit of engineering work in America. The Engineers' Club, which is rapidly becoming a widespread national body as to membership, is also, as originally intended by Mr. Carnegie, a beneficiary as to its own home, while the Union Engineering Building will now be able to subserve the wants and necessities of a large number of technical engineering societies which have hitherto had neither resting place nor meeting place. A total expenditure of about $2,500,000 is involved in the present plans.

We ventured to predict a few weeks ago that this would be the outcome of the complications of the past twelve months, and were satisfied that as on other occasions of great moment, Mr. Carnegie would rise to the emergency and deal with it in all its broadness of opportunity and obligation. He has, indeed, done a great and noble thing for engineering, one whose merits and benefits will grow as the years run by, and yet something which has been so sorely needed during the past twenty-five years that it is wonderful that no man with the means and the spirit had previously been equal to the occasion. Not only is a great engineering center thus created at the very heart of the Western metropolis, but Mr. Carnegie at once enables a large number of technical societies with a membership of perhaps not less than 15,000 to exercise their functions on the highest scale of efficiency. With each society sharing a common roof, and while the three trustee societies assume notable burdens in providing the land for the building, it is easy to see at once that many new ideas and benefits previously undreamed of must fructify. The national engineering societies, while maintaining their autonomy strictly, will find that co-operation enables them to address themselves more strictly to the needs of their members and the welfare of the public than was possible with each society dwelling in narrow quarters of its own or occupying rented rooms in some small house or office building utterly inappropriate for the purpose.

We believe that there is wisdom, enthusiasm and courage enough in the three national societies, thus so generously endowed by Mr. Carnegie, to execute this scheme on the best possible basis; and we trust that every engineer in the country, whatever his branch of work, will feel it his duty to rally to their aid and support. We consider it also a matter of happy augury that in this new engineering center, and adjacent to the great Union Engineering Building, will be found the Engineers' Club; for the social aspects of the professions are in many respects of equal importance with the technical, and the club now has a mandate which should stimulate it to the very fullest achievement of all the possibilities which lie

in these practical conditions. Hereafter from whatever part of the country or from whatever region abroad the engineer may come, he will feel drawn by every claim and association to the center now called into being. So far as the American Institute of Electrical Engineers is concerned, its members have from the first shown themselves enthusiastic over the project, and it is now their duty, as it will undoubtedly be their pride, to co-operate heartily with Mr. Carnegie in doing their share, which is not a small one, to secure the early consummation of the work in hand.

Invention vs. Current Engineering Development.

One of the most difficult matters with which patent courts have had to contend has been a determination as to what constitutes invention, and particularly as to what constitutes an invention as differentiated from a natural development occurring in the ordinary course of the evolution of an art. The fundamental principle applying, as laid down in an opinion by the United States Supreme Court, is that an invention must be the product of some exercise of the inventive faculty. Lacking a definition of what constitutes inventive faculty and a distinction between the inventive and ordinary constructive faculties, this dictum is of the kind that darkens rather than illuminates counsel. The courts being thus without direct guidance, and the determination of what constitutes invention being one of opinion rather than the result of a weighing of evidence, the natural consequence is a great and growing diversity of precedent on the subject. Naturally, the patent office is governed by precedents established by courts having patent jurisdiction, and is further circumscribed by a body of rulings laid down by past and present officials of the office. The net result appears to be that the criterion as to real inventive merit is so difficult to apply that any application for a patent covering anything new, provided that the alleged invention stands test with respect to priority and is not palpably a mere construction or obviously the result of ordinary mechanical skill, will receive favorable consideration and a patent duly issue. There are other and even more flagrant diversions of the intent in establishing the patent monopoly, arising through the grant of patents on what may be called "speculative" inventions, designed to cover future developments in an art, several notable instances of which have worked much harm in the electrical field. Of this class, however, it is not our intention to speak at present.

The great evil of the present looseness in the grant of patents is that undue advantage accrues to those who are in close contact with manufacturing operations and agents in the evolution of new types or in passing from smaller to larger constructions as changes are demanded by an industry. In such cases changes from current practice are usually definitely fixed by the conditions of each particular case, yet we venture to say that in the vast majority of instances, and even when change or improvement is not obvious to the mere onlooker, these conditions indicate what it shall be. In other words, the one who, through the Patent Office, profits by the opportunity, is apt to be merely a fortuitous factor in a situation brought about by the trend of progress, and the work he accomplishes could as well have been achieved by any one of his fellows. Were it not for the statutory monopoly of the fruits of such a situation which inures to the agent, there would be no cause for complaint, since the natural benefit of an opportunity cannot be denied to the one who grasps it. But the grant of patents on engineering improvements as they are in natural course indicated, is an injustice to those manufacturers whose line of work may later enter the field thus covered, and a still greater injustice to the public, which is made the victim of the monopoly which it instituted for beneficial ends. As to the remedy, this we believe will not be in legislation, but in a final appreciation by the courts of the situation which has developed during the past ten years, and which will result in drastic rulings sweeping away the abuse. The fact appears to be that electrical engineering so far as relates to its more important applications, is becoming more and more narrow as a field for invention, using that word in the sense implied in the statute awarding a monopoly to the maker of an invention. On the other hand, the field for the real inventor—the one who explores far away from beaten tracks—remains almost limitless. But the result of his work will not be mere improvements in design and construction clearly indicated by a set of new conditions, but radical departures or new and fundamental conceptions such as actually involve the exercise of the inventive faculty. This needs no further arguing in the day of radium.

The Transformer as a Fire Risk.

Mr. Rice's paper on the above subject, published elsewhere in our columns, raises some very interesting questions. Every one knows the good points of the air-cooled transformer in cheapness, efficiency and convenience, but on the other hand oil insulation has in itself remarkably valuable properties. At very high voltages oil is the only thing to use, but at the pressures in most general use air-cooled transformers are entirely applicable. So far as risks from internal causes go, we think the oil, particularly if rather heavy, has a considerable advantage. An air-insulated transformer can very easily catch fire from a short-circuited coil, and while the insulation is by no means easily inflammable, it will burn very persistently under sufficient provocation even for hours after the forced air supply is cut off. Oil, on the other hand, catches from internal causes only with great difficulty, but if once started in any way burns with a ferocity difficult to overstate. Given a sufficient degree of initial heat and even an oil-soaked brick floor becomes a raging furnace. Floors, in fact, are the most difficult proposition in fire-proof station construction for this very reason. Mr. Rice's suggestion of a separate transformer room, perhaps with an oil pit around the transformers, is thoroughly sound and in accordance with good recent practice. The separate building for transformers is secure in itself, but we think that the trouble of adequately securing the cables leading to it is not justified by any additional security gained in case of fire at the transformers. The leads from generators to transformers and from transformers out of the building, are the weakest points in a good many otherwise very excellent plants, like the switchboard connections. More plants are crippled from troubles of such sort than by accidents to any of the heavy machinery. Modern generators and transformers are wonderfully reliable, and no pains should be spared to make the working connections equally safe.

High Tension Insulation.

No structure electrical or other is stronger than its weakest point, and it is a matter of commonplace electrical knowledge that surface leakage is the weak spot of insulation for high voltage. So far as mere resistance to puncture goes, it is a perfectly simple matter to find insulation capable of withstanding many times the voltages now in customary use. Mr. Moody's preliminary paper to the A. I. E. E. discussion next week on high-tension work, in which he deals with the terminal precautions to be taken with high-pressure transformers, gives a vivid impression of the difficulties which recent practice has heaped upon the already rough path of the electrical designer. It is fairly easy, thanks to oil, to preserve the insulation of the transformer windings themselves at any voltage yet demanded, but to get the high-tension current out upon the line is quite another matter. At pressures of 50,000 volts and upwards there is a vigorous brush discharge from all the wires, and the surface resistance of ordinary insulators becomes greatly reduced, so that there might be sneaking discharges over comparatively long distances. The in-

sulaton of the transformer leads then becomes a problem even tougher than the insulation of the line, since the available distances are very limited in even a large transformer case. The scheme which Mr. Moody seems to have found most efficacious is to provide the lead itself with a local insulating sleeve strong enough to stand up under the working voltage, and then to bring out this insulated lead through a long porcelain bushing sufficient to give an adequate factor of safety. Aside from this, good results have been reached by bringing out the leads through oil tubes.

This matter of what one may call local insulation of high-tension conductors aside from the insulating supports, is one that deserves thorough study just now. Of insulating compounds having good mechanical properties and able to withstand moderate voltages, there are many, but when it comes to dealing with many thousand volts the number dwindles to evanescence. The really good insulators as regards withstanding surface leakage are very few, and none of them are all that they should be mechanically. Hence, Mr. Moody's general scheme of keeping down the potential available for causing surface discharges by insulation applied directly to the conductor as a coating, is both logical and effective. It is worth mentioning that the recent demand for extreme voltages is raising again the question of insulated wire, which has been practically abandoned for high-tension work. We are rather inclined to the opinion that no continuous insulation can be long relied upon even for the purpose of checking the coronal discharge into the air found at high pressures. There are serious oxidation effects at voltages producing a brush discharge in air which no ordinary form of flexible insulation can long withstand. An interesting corollary of the question here discussed is the proper factor of safety to be used in high-voltage insulation. Ordinary current practice requires a factor of 2 or 3, rarely more. The lower figure seems rather small unless one can be assured immunity from abnormal potentials on the line. At voltages from 20,000 to 40,000 the methods of insulation now in use, both on the line and in apparatus, seem to be fully adequate, but there are so few plants running at pressures above 40,000 volts that it is hard to get a line on the real behavior of insulation. In the region of pressures where coronal discharge is prominent, the situation is greatly complicated and insulation is a formidable question. The oil transformer renders it possible to get the pressures with reasonable facility, but insulation outside of the protecting oil is quite another matter.

THE INAUGURAL ADDRESS OF THE PRESIDENT OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The inaugural address last November of President R. K. Gray, of the Institution of Electrical Engineers in London has been published in a recent number of the *Transactions* of that body, and contains some very interesting facts and suggestions. The Institution of London was founded in 1871, thirteen years before the foundation of the American Institute of Electrical Engineers. The American Institute had at the beginning of the year a total membership of 2,800 after nearly twenty years of existence. The total membership of the British Institution at the same time was about 4,800 after nearly 33 years of growth. It is pointed out in the report that two-thirds of all the electric lighting in the United Kingdom is in municipal plants and only one-third in the plants of companies. In fact, if London, the main home of the companies, be excluded from consideration, nearly seven-eighths of the lighting is in the hands of municipalities. In the United States only about 5 per cent. of the lighting is municipal. The average rated capacity of a British station is about 1,400 kw, while that of the United States is only 340 kw. The total rated station capacity in Great Britain is, however, given only as 480,000 kw, while in the United States the total in June, 1902, was 1,200,000 kw. Consequently, while the average British station is four times as large as a United States station, the United States lighting is nearly three times as large as the British.

A noticeable feature in the address is that while candle-powers of lamps are less in Britain than with us, so that the standard lamp is the 8-cp lamp, yet the distributing pressures are generally higher, and 200-volt lamps much more common. In this country the large stations which commenced operations upon 110-volt lamps with the three-wire system, have not judged it to their advantage to change to 220-volt pressures. Nernst lamps are spoken of as a factor in British electric lighting, and also osmium lamps, which latter are curiosities in this country. They are described as having, in 25 and 30-volt pressures, an efficiency of ⅔ candle per watt and as showing but little diminution in light or efficiency after 800 or 1,000 hours of burning. The vertical-shaft design of steam turbine, now familiar in this country, is criticised, in comparison with the horizontal-shaft design, without, however, any facts in support of the judgment. The project of utilizing the Zambesi Falls for electric power transmission is alluded to. It is not generally known by Niagara worshippers in this country that the Victoria Falls of the Zambesi waste power to the estimated extent of 26,000 megawatts, or are five times as wasteful as the Niagara Falls, which before engineers attacked them wasted about 5,200 megawatts, or 7,000,000 hp. The plans under operation and present contemplation at Niagara propose to save about one-seventh of this for the world, or some 750 megawatts.

The total length of submarine cable laid in the globe is stated as 222,253 nautical miles, employing 47 cable ships, all told. It is some comfort to reflect that there is now as much cable laid on the globe as would reach in one length to the moon and leave a fair excess for slack. It is sad to see a President of an Institution of Engineers trying to withstay the inevitable stride of progress by advocating the general retention of the absurd old English weights and measures, that we also are yoked to. The statement is gravely made that in France precious stones are still bought in carats, milk in pintes, gravel in toises, and so on for about twenty indictments. The statement is true to the extent that these old units are still occasionally met with in France, just as here, in the United States, we occasionally yet find prices in terms of the shilling. But it is recognized by persons who have lived in France that it is just as unreasonable to speak of the general use of the old terms and units in that country as to say that the pound, shilling and penny still prevail here.

It is actually urged that the litre and the gramme are too limited to apply to all the things met with in daily life. The kilogramme is all very well for physics, but it is not adapted to charcoal. If we carry this proposition to its natural terminus, we should make the English weights and measures still more diffuse. Land should be exclusively measured, for example, in square chains, water in nothing but fathoms, houses only in feet, machines only in inches, horses in hands, men in cubits, and so on indefinitely. Particularly avoid common factors. What visions of rapture this exclusiveness of quantitative relation must conjure up in the bewildered imagination of the schoolboy! Whatever we learn, let it be hard; and whatever we say, let it be ambiguous. A large share of this excellent address is devoted to the recent advances in electrochemistry. The rate of growth of electric railways and the rate of increase in available electric pressures for transmission are also commented on at some length. The general breadth of topics and treatment is one of the noticeable features of the address.

A Union Engineering Building in New York.

New York City, already adorned with some fine buildings devoted to the arts and sciences, is now to enjoy the possession of a great central home for engineering, due, very appropriately, to the initiative and generosity of Mr. Andrew Carnegie, and carrying out ideas with which the public has become more or less familiar during the past year. The following letter gives the facts briefly:

ANDREW CARNEGIE, 2 East 91st St., New York.
March 14th, 1904.

GENTLEMEN OF THE MECHANICAL ENGINEERS; INSTITUTE OF MINING ENGINEERS; INSTITUTE OF ELECTRICAL ENGINEERS; ENGINEERS' CLUB OF NEW YORK:

It will give me great pleasure to devote, say, one and a half million of dollars for the erection of a suitable Union Home for you all in New York City. With best wishes, truly yours,

(Signed) ANDREW CARNEGIE.

It may be stated that the three national engineering societies named and the Engineers' Club, which, by reason of its widespread membership is also increasingly national in character, have, with the unanimous approval of all the memberships, already taken active steps to put into being the splendid trust for engineering thus created by a man whose own career has illustrated the upgrowth of the engineering and industrial arts in America. Mr. Carnegie is also a member of the Mechanical and Mining Engineers and of the Club. The total amount involved is not less than $2,500,000, for, in addition to the amount given by Mr. Carnegie, a sum of over $500,000 represents the investment in land for the three societies on West Thirty-ninth Street, between Fifth and Sixth Avenues; while the Engineers' Club has also acquired valuable land for its own purposes on West Fortieth Street, immediately facing the New York Public Library. The Union Engineering Building will probably be 12 stories in height, and will be laid out expressly with an eye to the services required of it. In many respects it will be unique. The three national engineering societies made trustees by Mr. Carnegie will have large headquarters there; and already several kindred bodies have made urgent requests for accommodation. There will be four or five auditoriums of different size, notably one to seat 1,200 to 1,500 persons; and all will be appropriately equipped for scientific meetings, lectures and demonstrations. Above all, there will be an engineering museum and a noble library hall, where all the libraries concerned will be grouped and consolidated, yet each section administered by its respective Society librarian and each adding to its own specific literature, so as to avoid duplication of outlay for books or periodicals. It is proposed, moreover, to co-operate intimately with the New York Public Library, nearby, along these lines of work, so that nowhere else in the world can the student or practitioner find thus freely available the whole literature of engineering and technical industry. The three libraries assembled in this manner will even at the outset include some 50,000 volumes, many of them great rarities of inestimable price.

The three societies, each of course maintaining its identity and autonomy, will themselves need considerable room in the new building, which it is hoped to have ready in 1906. They have a total membership to-day of over 9,000, and are growing at a rate of between 10 and 15 per cent. annually. They administer a total income of $135,000 annually and in assets of all kinds have property to the value of between $250,000 and $300,000, a sum to which the gifts of individual members are now adding rapidly. The sister technical societies asking for quarters and facilities represent also another great body of over 5,000 members, engaged in all branches of civil, mechanical, electrical, municipal engineering, etc. Large, therefore, as the Union Engineering Building, with its frontage of 125 ft. on five lots, may seem, it bids fair from the start to find every inch put to fructifying use. The Engineers' Club Building, a separate entity, will immediately flank the Union Building, the two sharing the same resources of light, heat and power, and being most advantageously situated for intercommunication and mutual social benefit. The club, with a long waiting list, has just increased its membership to 1,200, and administers a budget of about $120,000 a year. The buildings, facing thus on two streets, are to harmonize as to architecture, as they do virtually in function, as homes of engineering, and their central position commanding all lines of travel at the very heart of the city, insures the acme of convenience to visitors from outside the city or from abroad, as well as to all local members.

The three societies provide the land, but in the meantime Mr. Carnegie has promptly acquired it for them. The leases run out about July 1 and work will then begin forthwith and be pushed ceaselessly to completion, as the building is in reality sorely needed by the bodies that are to occupy it, and that now chiefly occupy rented quarters ill-suited to their purposes. The Engineers' Club has also already made purchases of land for itself on West Fortieth Street, not far from the new Republican Club opened recently. Plans for the architectural part of the undertaking have already been drafted, and the architects will soon be selected. The representatives of the four bodies interested as the direct beneficiaries and trustees of Mr. Carnegie's splendid gift to engineering are as follows: American Society of Mechanical Engineers—Prof. F. R. Hutton, C. Wallace Hunt, J. M. Dodge. American Institute of Mining Engineers—Dr. A. R. Ledoux, Theodore Dwight, C. Kirchhoff. American Institute of Electrical Engineers—C. F. Scott, Dr. S. S. Wheeler, Bion J. Arnold. The Engineers' Club—J. C. Kafer, W. H. Fletcher, T. C. Martin. These as a conference committee have carried the matter patiently through its earlier stages and are now vigorously engaged in working out all the details of an enterprise which, recognizing frankly the close interdependence of all branches of engineering, endows them jointly with means for professional and educational work never before enjoyed in any country by such organizations, or on such broad conditions of public welfare; leaving, nevertheless, to the societies their distinctive and individual conditions of existence.

Tesla's Split Phase Motor Patent Decision.

Judge Hazel, of the United States Circuit Court of the Western District of New York, has handed down an opinion sustaining the two Tesla fundamental patents (Nos. 511,559 and 511,569), covering the split-phase motor. The suit was instituted by the owners of the patents against the manufacturer of a wattmeter, and the court held that the wattmeter infringed the patents for the reason that it depended for its action on two currents differing in phase, derived from a single supply circuit.

The patents involved were the same that figured in the Catskill case, in which suit they were sustained by the Circuit Court, but declared invalid upon appeal. This reversal was on the grounds that the publication of a magazine article on April 22, 1888, by Prof. Galileo Ferraris fully described and disclosed the system covered by the patents. This publication was held to be prior to the date of the invention in suit and constituted an anticipation.

Judge Hazel, in his opinion, disagrees very materially with Judge Townsend, who wrote the opinion on appeal, declaring the patents invalid. The conflict arises from the different weight which the two judges gave to the testimony of the several leading witnesses, this testimony being held by Judge Townsend to be inconclusive, and by Judge Hazel to establish clearly that Tesla conceived the invention prior to the publication of the Ferraris article. Judge Hazel considers that, according to the testimony, Tesla conceived his split-phase invention in his laboratory at 89 Liberty Street, New York, and completed the same in the month of September, 1887; and that he made the disclosure thereof to others during the fall of 1887, especially to Mr. Brown and Mr. Nellis, and subsequently in the month of April prior to the Ferraris publication to his solicitor, Mr. Page.

Washington Meeting of the American Electrochemical Society.

The fifth general meeting of the American Electrochemical Society will be held at Washington, D. C., April 7, 8 and 9, 1904, in the hall of Columbian University. Thursday and Friday afternoons will be devoted to visits to scientific laboratories, government institutions and various points of interest in and about Washington. On Thursday evening the presidential address will be delivered and will be followed by a complimentary smoker. Friday evening there will be a subscription banquet at the Shoreham, corner Fifteenth and H Streets, N. W., at which hotel headquarters will be maintained. Among the papers announced are the following:

"The Composition and Resolution of Voltages," by Dr. J. W. Richards; "Notes on the Industrial Electrolysis of Water," by Mr. W. S. Landis; "Standard Cells," by Dr. F. A. Wolff; "Electric Smelting Experiments for the Manufacture of Ferro-Nickel from Pyrrhotite," by Ernest A. Sjostedt.

Reconstruction of the Zanesville, O., Railway, Light & Power Company's Property.

THE property of the Zanesville Railway, Light & Power Company has been undergoing an almost complete reconstruction during the past eighteen months. As many other properties are in a position where such reconstruction is being considered, the present article, telling how this reconstruction was accomplished in Zaneville and the results, will no doubt be of interest. The old power plant of this company consisted mainly of high speed simple non-condensing engines and a conglomeration of belts and line shafting for transmitting the power to generators such as is familiar to most of our readers. This plant is to be entirely abandoned.

The new plant consists entirely of steam and water turbines. There are no reciprocating engines driving generating machinery in the plant.

LOCATION.

A remarkably fortunate location was selected for the new plant, as shown in Fig. 1. It is on the bank of the Muskingum River, between the river and a canal maintained by the Government. In order to supply water to this canal, the government maintains a wooden crib dam in the Muskingum River just above the power plant, as seen in Fig. 1. The water power obtained by this company is therefore secured at no expense for the maintenance or construction of a dam or canal. The only expense connected with the development of the water power has been the building of the water power station itself. In this plant, water power is not depended upon entirely, as there are times when, owing to the great amount of flood water going over the dam, the head of water at the power house practically disappears. A steam power plant sufficient to carry the full capacity is therefore placed in the same building, but it is expected that water power will be sufficient during a large portion of the time to operate the plant. Since in this case the expense of the hydraulic development was comparatively small, the engineers considered that they could well afford to install a hydraulic plant for the sake of power that could be obtained, even though this power could not be relied on every day in the year.

Just below the power house is a bridge, and from the street railway tracks on this bridge a spur is run to the power house for the purpose of carrying coal and other supplies. A side track of the Baltimore & Ohio Railroad also reaches the plant at one end. The power house is located on a solid ledge of rock, as can be seen from Fig. 3, which was taken during construction. This shows the ledge of rock on which the power house and the excavation made for the tail-race and also the concrete arch construction over the tail-race.

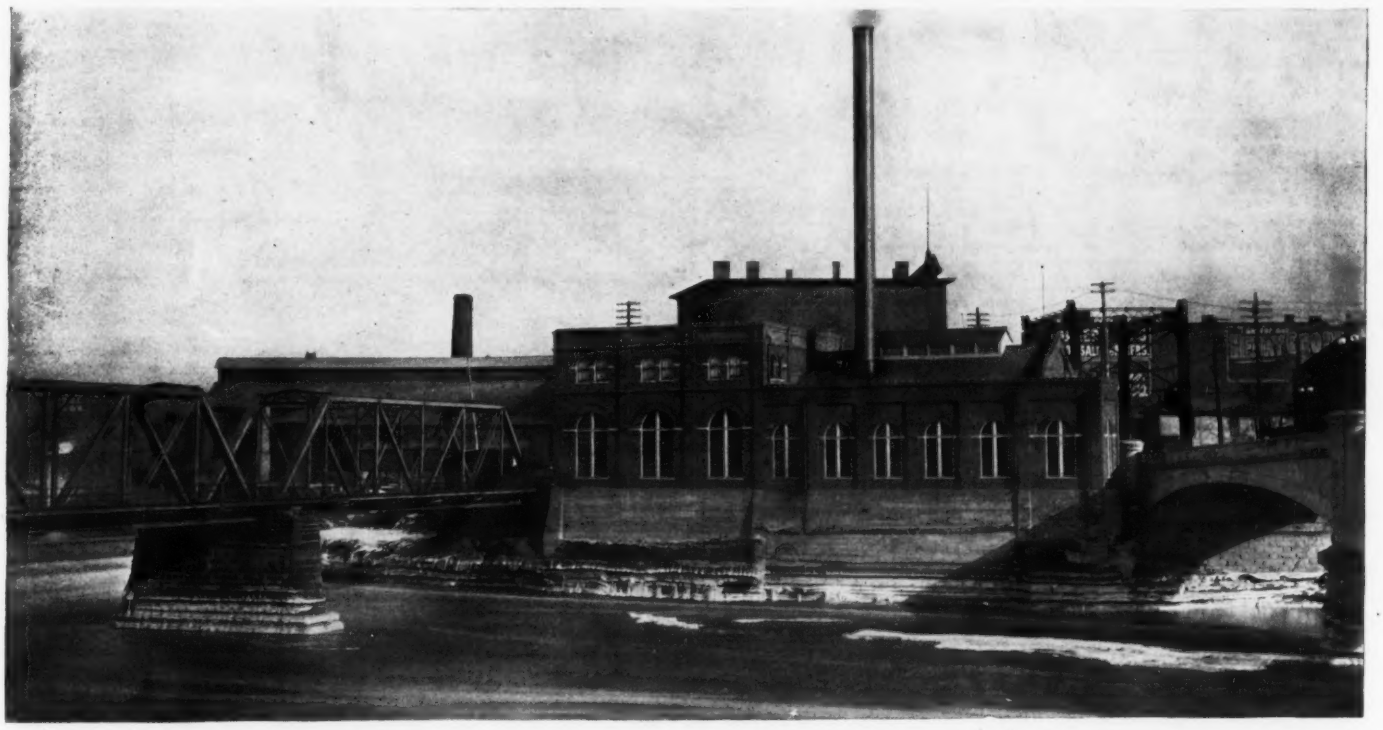


FIG. 1.—GENERAL VIEW OF POWER PLANT AT ZANESVILLE, OHIO.

CONSTRUCTION AND ARRANGEMENT OF BUILDING.

The water passes under the down stream end of the building. The ordinary level of the tail water is thirteen feet below that of the head water, giving a 13-ft. head on the wheels. This head disappears in times of freshets, as maximum high water comes very nearly to the top of the concrete foundation wall, which is carried up to the level of the engine and boiler room floors.

The up-stream end of the station contains the steam turbine units. Fig. 2 is a section through this end of the station. At the right are stairs leading to the switchboard gallery. The basement floor is thirteen feet below the engine room floor; the basement containing the turbines and condensers, while the generators on the vertical turbin shaft are above the level of the main floor. All the foundations of the building are concrete laid on solid rock. The roof is slate with copper gutters. The floors are black and white tile with white tile wainscotting. The building is of Zanesville pressed brick.

APPARATUS IN STATION.

The five water wheels seen in the sectional elevation in Fig. 2 are each 51-in., 275-hp vertical shaft turbines, of the open-flume type, made by the Stilwell, Bierce & Smith-Vaile Company. These turbines run 80 revolutions per minute and are geared through bevel gears to a line shaft running 200 revolutions per minute. On each end of this line shaft is a 375-kw General Electric, 60-cycle, 2,300-volt generator. Fig. 5 is a view in the shaft house, showing the shaft, bevel gears and Lombard water wheel governors. The shaft house is partitioned off from the generators at either end.

In the steam turbine room, Fig. 6, are two 500-kw Curtis steam turbines, designed to operate at 180 pounds steam pressure, in connection with Stilwell-Bierce surface condensers. Fig. 7 shows one of these turbine units with its condenser piping. The centrifugal circulating pump is motor driven. Provision has been made in the generator room for two more steam turbine units of this size. The rotary converters mentioned later are also in this room.

In the boiler room resting on a concrete floor over the head-race are two 380-hp Heine water tube boilers, with two Stilwell-Bierce feed pumps. The boilers are hand-fired. Coal is shoveled directly from the cars on the siding into the space in front of the boilers. Provision has been made for doubling this boiler capacity.

About 25 per cent. of the load of the station is supplied to alternating-current lighting circuits. The remainder is used in rotary converters to give 550-volt current for railway use and 110 volts for the three-wire direct-current network.

For railway purposes one three-phase transformer takes the 2,300-volt current and reduces the voltage for use in a six-phase, 60-cycle rotary converter for supplying the street railway.

To supply the direct-current lighting network two three-phase transformers step down the 2,300-volt three-phase current for use in two 240-volt rotary converters. The balancing is done by a connection of the neutral of the star-connected rotary converters.

Both the railway and lighting rotary converters are supplied from the same generators. This has been made possible by connecting in multiple with the railway bus-bars, 256 cells of Chloride accumulator. This storage battery is connected in series with a differential booster, which causes the battery to take the fluctuations of railway load and leave a practically steady load on the generators. The cells of this battery are type G, with 17 plates per cell. The tanks are large enough to allow 50 per cent. increase in plate surface. The differential booster is large enough for the ultimate capacity of the cells. This battery is rated at 640 amperes at the one-hour rate of discharge. Provision has also been made in the battery room for a battery to operate in connection with the three-wire direct-current lighting system. The battery room is shown in Fig. 4.

The value of a battery was forcibly demonstrated last winter during the holidays. The maximum railway load amounted to 660 kw. If there had been no battery, this would have been beyond the capacity of the water supply which was then available for use. The average load was only 220 kw. The battery took the fluctuations so that the plant was operated with one wheel at full gate and one wheel at sixteenths full gate.

No exciters have been provided for this station for the present. The engineers considered that with the battery in case all the direct-current machinery should be shut down, current for excitation can be obtained therefrom.

The battery room is on a floor above the generator room. It has the regular floor now commonly employed in storage battery rooms, consisting of tile laid in asphaltum, and is drained with lead-lined iron pipes.

The high-tension switchboard in the gallery was furnished by the General Incandescent Arc Light Company, and has "G. I." hand-operated oil switches. Two General Electric potential regulators will be employed on the alternating-current lighting feeders. These regulators will be operated to raise and lower the voltage, by means of small alternate-current motors. The transformers are air-cooled.

As stated before, the water wheels are governed by Lombard governors. The speed of the wheels can be varied from the switchboard by means of a direct-current motor at the governor for shifting the governor weight.

Street lighting for the city which has been done formerly by direct-current arcs will be done hereafter with 6.6 ampere G. I. differential enclosed arcs, 250 in number, 25 on a circuit.

ECONOMIES BY THE RECONSTRUCTION.

Of course, a great economy in operation is anticipated as a result of the abandonment of the old power station. As said before, much of the total output in a year will be generated by water power, and therefore at no fuel expense. That portion of the power supplied by steam should certainly be generated with much greater economy than in the old plant. The old plant used twelve pounds of coal per kilowatt hour. The new 500-kw Curtis turbine units are guaranteed to operate with twenty pounds of steam per kilowatt hour. If eight pounds of water can be evaporated per pound of coal in the boiler plant (which the engineers assume is a reasonable figure), the turbines would give a kilowatt hour for two and one-half pounds of coal. The repairs in the old plant were enormous. In the new plant it is believed that they will be very low, as there are so few moving parts, as compared with the old, and the electrical apparatus is confined to large units of modern construction. In the old plant seventeen men were required for its operation. In the new plant six men are required.

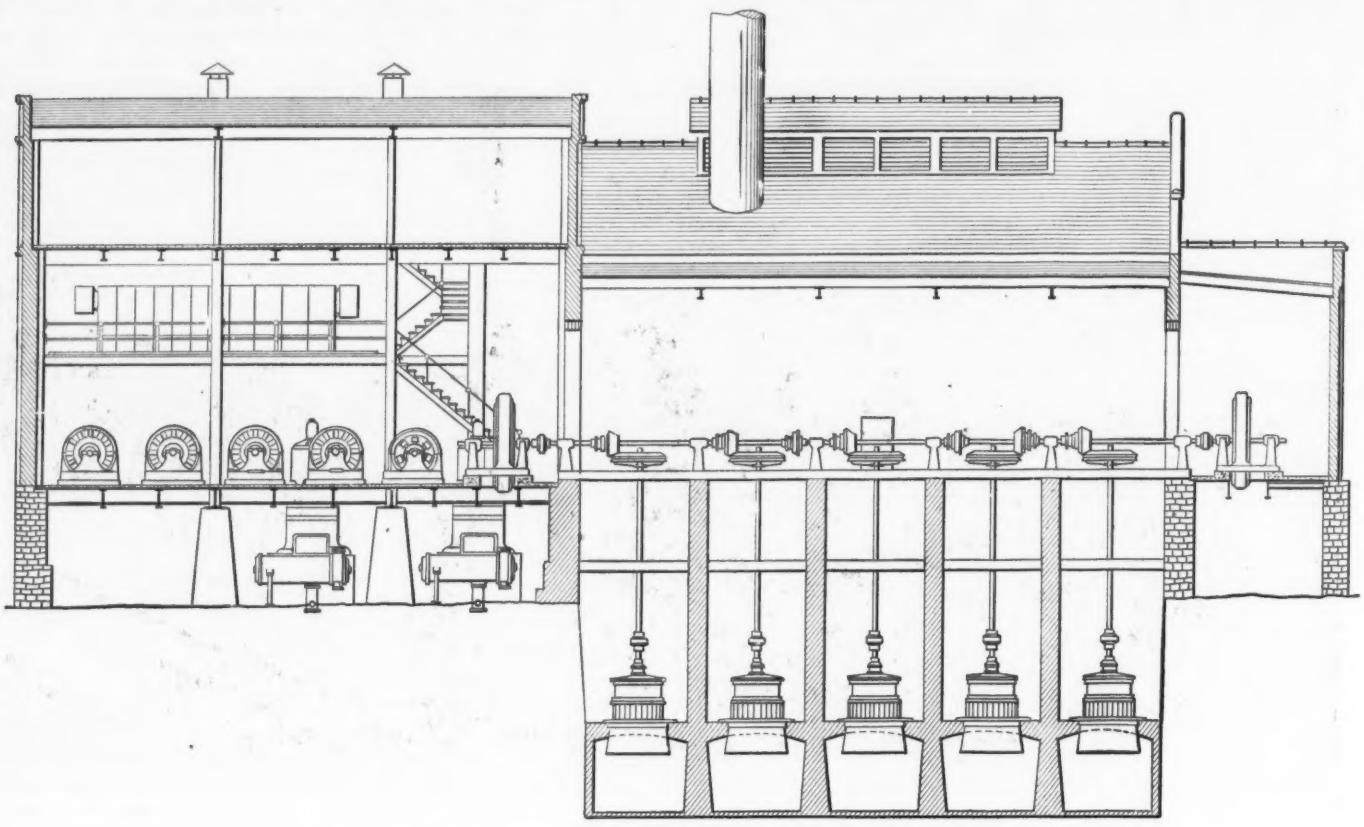


FIG. 2.—SECTIONAL ELEVATION OF POWER HOUSE.

Making allowance for interest and depreciation, the engineers estimate that there will be a yearly saving of $18,000, as compared with the operation of the old plant. The cost of reconstruction, which includes also rebuilding of much of the street railway track and the purchase of entirely new rolling stock, so as to bring the street railway system to a standard guage, was $400,000. The present connected load is the equivalent of about 14,000 16-candle power lamps. Excluding the small sized motors, there is a motor load of 300 kw, distributed among 35 motors.

Since the present management took charge the earnings have increased about 20 per cent. Last year railway earnings were about $110,000 and light $65,000. The operating expenses are about 55 per cent. of the gross earnings. The base rate for power and light is 10 cents per kilowatt hour. About 350 kw additional power load is soon to be taken on, and it is further anticipated to transmit power to nearby pottery towns which, as is well known, are good power consumers. Coal costs the company $1.40, delivered. The company now has outstanding $1,000,000 in bonds and $1,000,000 in stock.

Rudolph Kleybolte & Company, bankers of Cincinnati, New York

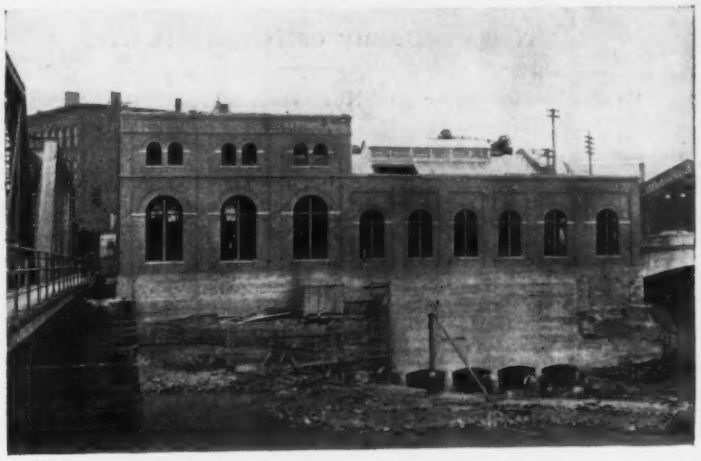


FIG. 3.—ROCK FOUNDATION OF POWER HOUSE.

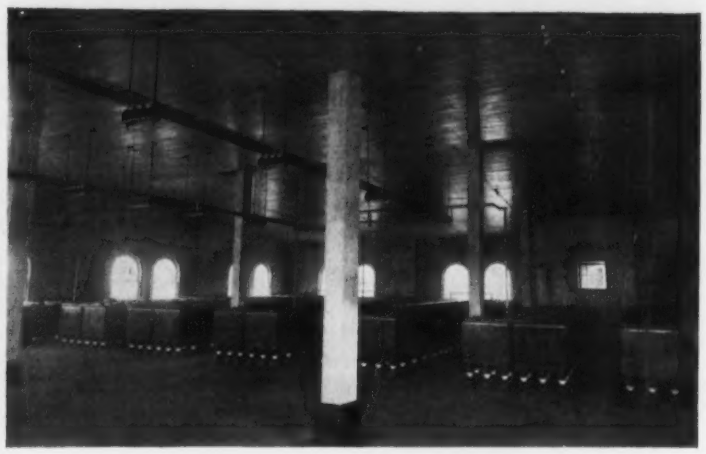


FIG. 4.—GENERAL VIEW OF STORAGE BATTERY ROOM.

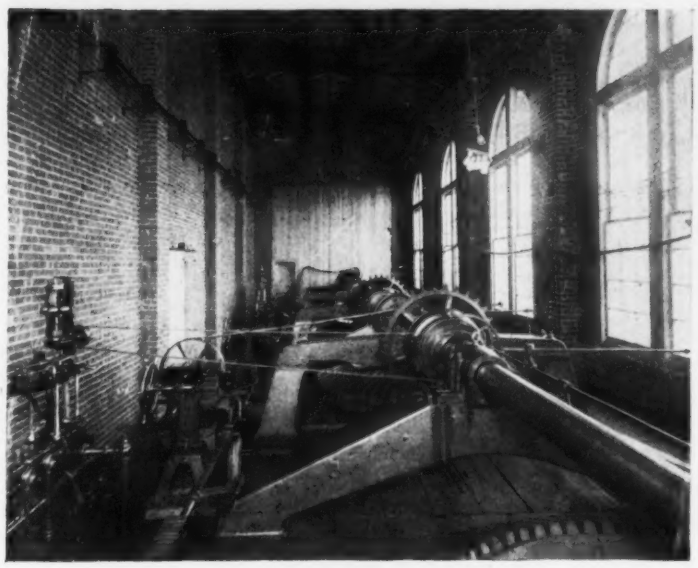


FIG. 5.—VIEW OF SHAFT HOUSE.

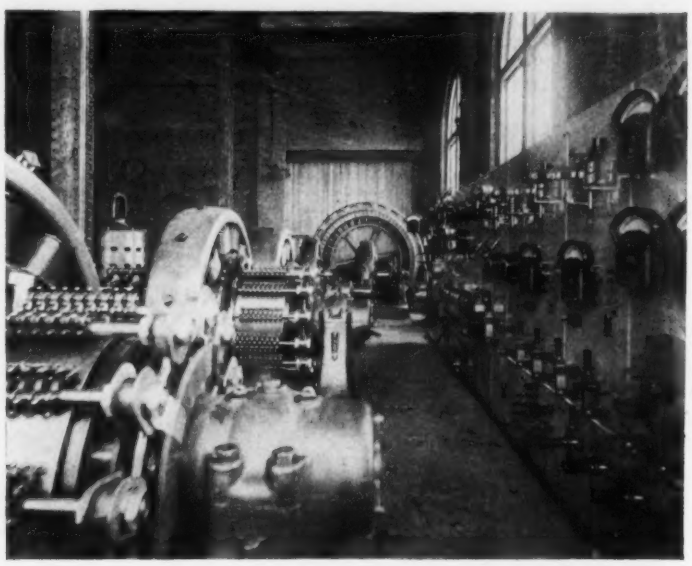


FIG. 6.—VIEW OF TURBINE ROOM, SWITCHBOARD, ETC.

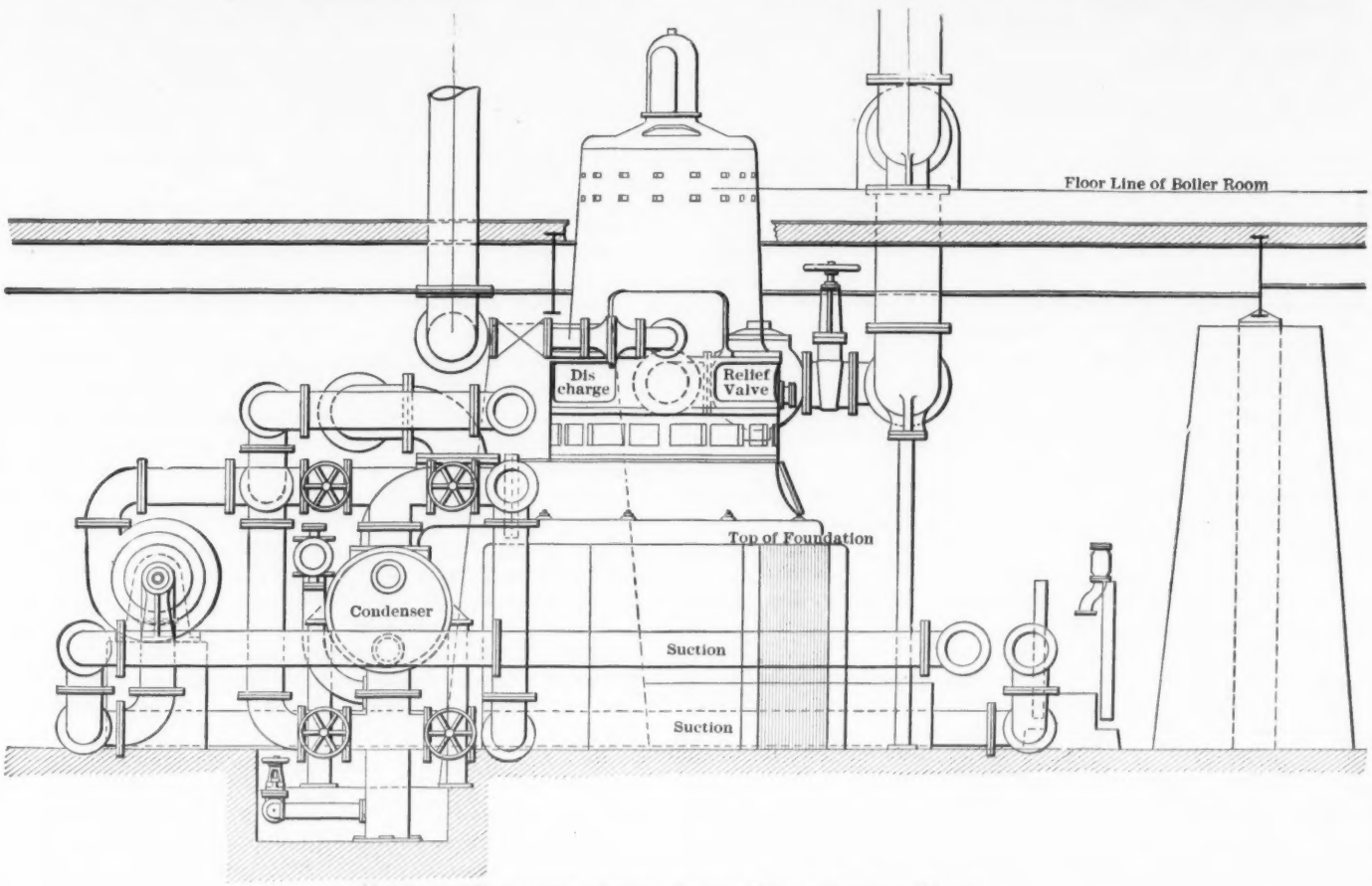


FIG. 7.—ELEVATION OF ONE OF THE STEAM TURBINE UNITS.

RECONSTRUCTION OF THE ZANESVILLE (OHIO) RAILWAY, LIGHT & POWER COMPANY'S PROPERTY.

and Chicago, undertook the reorganization of the properties now merged in the Zanesville Railway, Light & Power Company, in September, 1902, their contract providing for, not only the reorganization of the securities of these properties, but also for their complete physical and operating reconstruction. Kleybolte & Company, in turn, contracted with H. M. Byllesby & Company, of Chicago, for all the engineering work connected with the rebuilding of the property, the designing of the new power house and its contents, and H. M. Byllesby & Company, in connection with Messrs. Kleybolte & Company, also had charge of the reorganization of the operation of the properties.

Under the reorganization, all the former operating officials were retained; Hon. F. A. Durban, of Zanesville, being elected president; H. M. Byllesby, vice-president and engineer; W. A. Gibbs, general manager and assistant treasurer; W. D. Breed, of Messrs. Rudolph Kleybolte & Company, secretary and treasurer. Mr. Gibbs had been in charge of the properties under the former management for several years, and under the reorganization his powers and duties were largely increased and he had a prominent part in the reorganization of the operating conditions and in the reconstruction of the properties in connection with H. M. Byllesby & Company. Mr. Gibbs, together with E. C. Braun, one of the engineeers of H. M. Byllesby & Company, had charge on the spot of the reconstruction of the property.

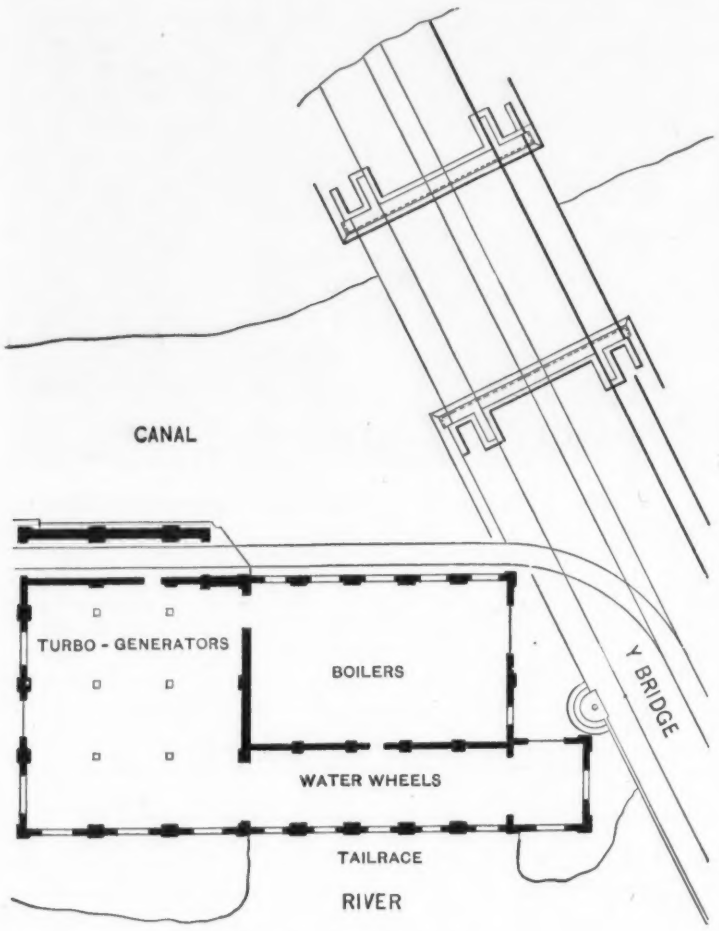


FIG. 8.—PLAN OF POWER HOUSE, ETC.

The street railway system, comprising some 14½ miles of track, was of 5-ft. 2-in. guage laid with rails ranging from 36 to 70 pounds per yard. Along with the reconstruction of the power house, the street railway system was reconstructed to bring it to standard gauge. This also called for a new rolling stock. The track as reconstructed now consists of 70-pound standard A. S. C. E. T rail in dirt streets and 70-pound Shanghai T in paved street. Eight of the 14½ miles of track is in paved street. Ties are 6 in. x 8 ft., laid two feet between centers. Atlas rail joints were used. The trolley is No. 0000 wire. The bonds and overhead material were furnished by the Ohio Brass Company. These cars are equipped with four 25-hp G. E. motors. Eighteen cars are operated during rush hours and ten upon ordinary schedule.

Niagara Beauty or Niagara Power.

At the hearing before the New York State Senate Committee on Miscellaneous Corporations at Albany on the bill to increase the water rights of the Niagara, Lockport & Ontario Power Company, Charles M. Dow, president of the Board of Commissioners of the State Reservation at Niagara, vigorously objected to the measure. Among other remarks, he said: "Owing to the greater declivity of the river bed on the Canadian side, as well as the wider expanse of the Horseshoe Fall, it is estimated that only one-fifth of the whole volume of the river passes over the American fall. Furthermore, owing to the difference in elevation of the Canadian and American river beds, the water has a tendency to gravitate toward the Canadian fall, and the American fall is the first to show the effect of any subtraction of water from the river above. As the general depth of the water on the fall is only about four feet, and as the elevation of the American fall is something like six or seven feet above that of the Canadian fall, it is apparent that the American fall might be made entirely dry while water still poured over the Canadian fall. That such a discrepancy would appear in the event of the diversion of a sufficient amount of water is not simply a theory; the fact was demonstrated in 1848, when the flow of the river was diminished by an ice blockade at the foot of Lake Erie, and on a lesser scale by more recent ice gorges.

"From the foregoing it will appear that the diversion of 20 per cent. of the water of Niagara River would be sufficient to render the American fall as dry as the once famous cataract of Lodore in England. Now, let us see what the State has already done to accomplish such a disastrous result: The reservation had hardly been created, for the express purpose of preserving the scenery of the falls, when the Legislature began, with singular inconsistency, to give away gratuitously the very water upon which the existence of the falls depends. Seven corporations were granted charters to take water from the Niagara River, between 1886 and 1894, besides another corporation which is taking water without authority, making eight American corporations which have either been authorized or are taking water without authority from the river. There are two Canadian corporations, for which the New York Legislature is not responsible, of course, but the effect of whose operations upon the flow of the falls must be reckoned with.

"Some of these corporations are limited in the amount of water which they can divert. More are unlimited. One limited American company alone is authorized to develop 200,000 hp, requiring 6 per cent. of the volume of the river. With a similar development by its corresponding company on the Canadian side, the flow of the river will be diminished about one-eighth—sufficient to dry up the American fall, according to one estimate. A similar development by all of the companies in existence would rob Niagara of one-third of its volume, and insure the obliteration of the American fall beyond a peradventure."

Evansville Municipal Telephone Company's Trouble.

There is trouble existing among the stockholders of the Evansville Municipal Telephone Company, which threatens to disrupt the organization and defeat the unique scheme of its chief promoters. Ten months ago the City Council of Evansville refused to renew the franchise of the Cumberland Telephone Company, and a movement was started by Mayor Covert and others to organize a municipal company to install a plant in the city and drive the Cumberland Company out of the city. Stock has been subscribed to the amount of $78,000 and a call was issued nine months ago for a payment of 30 per cent. of it. According to the plans and promises of the promoters, the stockholders were to receive an annual dividend of 7 per cent. and all other surplus was to go toward retiring the stock. It was figured that at the end of 20 years the city would own the plant.

Out of patience in waiting to see something done, stockholders representing 430 shares of stock held a meeting recently and demanded that the directors make a statement. There were many heated debates and the directors were charged with being negligent and with not having the municipal idea at heart. Those present insisted that something be done toward installing a plant and threatened the directors that unless they make a report a receiver will be asked for and the company's business closed out.

The Electric Power and Transmission System of Schaffhausen, Switzerland.—II.

(*Concluded.*)

STORAGE BATTERY.

THE storage battery which is used for reserve power for the railway service is located in a separate building on the left side of the Rhine between the two power stations. The battery consists of 276 elements and has a capacity of 165 amp.-hours. The battery room is illuminated by four incandescent lamps. A repair shop is located in the same building.

OPERATING COMBINATIONS.

Under normal conditions the lighting circuits are fed by the two single-phase alternators in the lower station, and the power circuits (including the railway) are fed by the two alternators in the upper station. Should an accident occur the single-phase-polyphase reserve generator in the lower station can be operated in parallel on the lighting circuit. If, however, one of the power service generators in the upper station is disabled the reserve generator can be used for the power circuits. By the use of this reserve generator danger of service interruption is reduced to a minimum.

SINGLE-PHASE DISTRIBUTION.

Six cables leave the lower station carrying single-phase current for lighting and small power work. They are carried in wooden casings over the iron bridge to the shore. Four of these cables have a cross-section of 2 x 60 mm. and two are 2 x 20 mm. Each cable is double and concentric, one part being for the outgoing current and the other for the return.

One circuit, forming the core of the cable, consists of copper strand insulated and lead-covered. The other circuit consists of copper strand spun around the inner lead covering. This strand is also insulated and protected by a double cover of lead. To prevent injury in handling, the complete cable is covered with asphalted linen. The resistance between the inner and outer cables is 1,120 megohms and between outer cable and earth 1,140 megohms.

Both primary and secondary cables are laid in clay pits filled with fine sand. When primary and secondary cables are laid in one pit, additional safety is secured by laying the primary cable about 120 mm. lower than the secondary. This makes it possible to repair the low-tension cable without coming into contact with the high-tension cable. Wherever possible, branching of the high-tension cables takes place in the transformer stations. The high-tension cables consist of 7.511 km. 2 x 20 mm. concentric cables, 2.799 km. 2 x 40 mm. concentric cables and 5.645 km. 2 x 60 mm. concentric cables, making a total length of 15.955 km (9.6 miles).

The transformers, which reduce the 22,000-volt current to 120 volts, are set up in cylindrical iron houses. Two types are used for underground entrance of the primary cables and underground exit of the secondary cables. For underground primaries and overhead secondaries these houses are furnished with masts. Those for overhead work are outside the city limits.

Each of the four door houses has room for two 20-kw transformers. On one side of the interior there is an iron framework for carrying the transformers and a double-pole switch controlling the high-tension current going to the next transformer station. The second side carries two double-pole, high-tension switches operated from the third side to control the transformers. The fourth side has two marble panels, the upper one carrying two double-pole, low-tension switches for transformer control, and protective devices, and the lower panel a double-pole switch for the outgoing low-tension cables as well as safety contrivances.

The houses arranged for overhead work are, in addition to the above, equipped with lightning arresters.

Besides these transformer stations there is also one located at the center of the city. It is reached by ladder from the street surface through a shaft covered by wooden and iron covers. This room contains four transformers with switchboard and arrangements for ventilation and sewerage. There are in use 28 transformer stations using 33 transformers, taking 630 kw.

As the tension of the two-wire system is 120 volts and of the three-wire system 240 volts, all transformers have two secondary windings, which can be arranged in parallel for the former system and in series for the latter. All wires of the three-wire system are buried, but in general the two-wire system is an overhead one.

FIG. 5.—SECONDARY SIDE OF TRANSFORMER HOUSE.

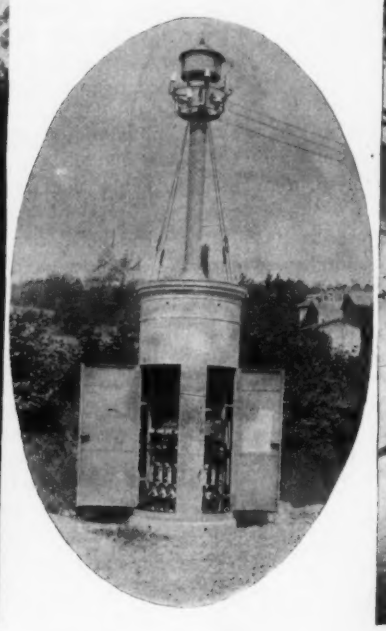


FIG. 6.—TRANSFORMER HOUSE.

FIG. 7.—HIGH-TENSION SIDE OF TRANSFORMER HOUSE.

The overhead wires are carried on double-covered insulators mounted on zinced iron supports attached to wooden poles 30 to 32 ft. high. These poles are covered with cast-iron caps and at exposed places are also furnished with lightning protection.

The length of the buried secondary network, consisting of 15 mm., 25 mm., 50 mm., 100 mm., 150 mm., and 200 mm. cables, is 16.327 km. (10 miles). The total length of the overhead secondary wires is 36 miles and weighs 9.2 tons. The total number of private consumers is 353.

All public arc lamps are separately shut in and out of circuit by water-tight switches. An automatic timing method is also being tried at present. The public incandescent lamps are all of 25 cp. There are in use 11,007 incandescent lamps and 88 arc lamps. There were also 22 motors on this circuit using in all over 39 hp. The total capacity of this system is 675,462 kw-hours.

POLYPHASE DISTRIBUTION.

Two triple 3 x 60 mm. cables laid in clay pits are led from the upper station to the lower one. At the latter station the cables branch, one being led to the three-phase motors running the railway generators and the other to a city distributing station. All of these cables are triple, have double lead covers and asphalted linen protection. The middle insulation resistance of each cable is 2,500 megohms per km.

From the main polyphase distributing station cables are led to ten

sub-stations as well as a number of factories. Each station is furnished with a three-pole switch and other regulating and protective devices. Five of these polyphase stations also contain transformers and controlling apparatus.

Nine 1,900-volt, three-phase motors taking a total of 815 hp are used on this system, the largest being the two 150-hp motors used in connection with the railway generators. Another 150-hp motor is used in a worsted mill. The other motors are distributed among a dyeing establishment, nail factory and the Engestieg, Rheinalde and Breite pumping stations.

The low-tension polyphase motors on this system operate at 190 volts. At present there are 28 in use, totaling 318 hp. The largest motor used has a capacity of 30 hp. The total product of this system in 1901 was 1,144,721 kw-hours, and the maximum for one day 5,025 kw-hours.

SCHAFFHAUSEN CORD WORKS.

The power for operating the machinery in the Schaffhausen Cord Works is transmitted from the upper station through a 3 x 250 mm. high-tension cable. This cable divides into four parts at the factory switchboard. One of these three-phase branches gives but two phases to a 5-kw transformer which steps down the voltage to 240 for lighting the works. If necessary, the lighting circuit can be connected to the city lighting mains. This circuit feeds 230 16-cp incandescent lamps and three 14-amp. series arc lamps.

All the motors are operated at 390 volts. The motor equipment comprises six 50-hp motors and one 35-hp motor. All motors transmit power through belting.

SCHAFFHAUSEN WORSTED MILLS.

As has been stated before, the Schaffhausen Worsted Mills receive the power generated by two hydro-electric sets in the lower station. Current is transmitted by two overhead cables, each consisting of two cables each made up of 37 strands 32 mm. diameter. The overhead transmission in crossing the Rhine has a single span 100 m. long and enters the motor station of the worsted mills.

In this station the cables are led to double-pole switches, which

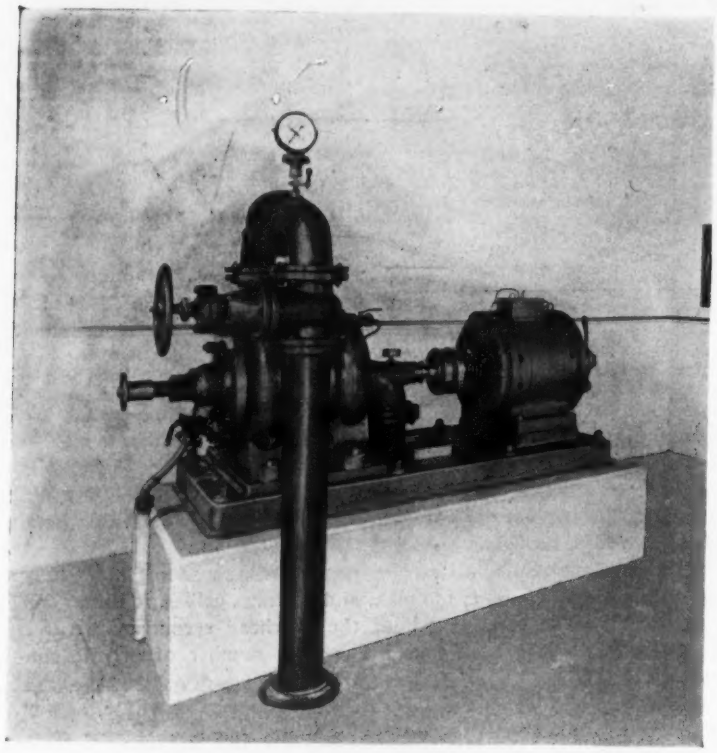


FIG. 8.—35-HP, THREE-PHASE MOTOR, BREITE PUMPING STATION.

are opened during lightning storms and outside of working hours. The cables also have lightning protection. They are led underground from these switches to the distributing switchboard, which contains the necessary instruments for controlling the branch circuits.

The motor station contains a 350-hp twin motor, which, through a rope drive, formerly operated the chief transmission system of the mills. This twin motor, which consists of two dynamos, is no longer used as a motor, but serves as a reserve generator operated by a steam engine in case the outside transmission system fails.

Every motor is operated at 650 volts and is furnished with a separate control panel including two-pole switch and ammeter. The present motor equipments of the mills include one 135-hp motor, five 60-hp motors and two 30-hp motors.

SCHEDULES.

The following charges are made to power users:

For all purposes, except lighting, 3.86 cents per kw-hour. The rebates are the same as those given below for lighting circuits; but there is a minimum annual charge of $9.65 (50 francs) per kw capacity of the individual station used by the consumer. The lowest

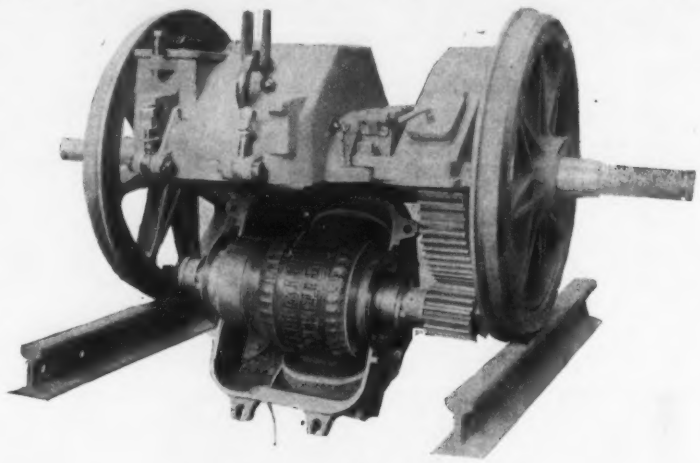


FIG. 9.—RAILWAY MOTOR.

price, namely, 3.86 cents, applies only from midnight to twilight. If the motors are used at night during lighting hours special terms are made.

Light consumers are charged 11.58 cents per kw-hour., and a minimum of $6.95 per annum.

In the following table the second column gives the rebate for using more than the amount specified in the first column opposite:

Dollars.	Rebate.
19.30	2 per cent.
48.25	4 " "
96.50	6 " "
193.00	8 " "
289.50	10 " "
482.50	15 " "
965.00	20 " "

Larger special discounts are given to consumers using more than $1,158 (6,000 francs) of power.

The minimum annual cost per horse-power using separate polyphase stations is $28.95 for low-tension motors and $24.13 for high-tension (2,000-volt) motors of 50-hp or greater capacity.

The single-phase circuits may be used continuously except for two to four-hour intervals, on Sundays and holidays. The polyphase system gives current every day except Sunday and holidays from 6 A.M. to 7 P.M. As the railway depends on this system consumers do not receive current outside of the hours named unless the conditions are favorable.

THE STREET RAILWAY SYSTEM OF SCHAFFHAUSEN.

The Schaffhausen-Neuhausen line begins at the southern end of the steam railroad station in Schaffhausen, passes to the Oberthor, crosses the government steam railroad below grade and ends in the center of Neuhausen in front of the Hotel Rheinfall. The second line (Breitelinie) runs between the railroad station and Marksmen's House. The third line connects the Emmersburg quarter and the railroad station.

All of the lines are single-track construction with turn-outs averaging 263 ft. in length. The distance between track centers is about 8 ft., leaving a clearance of 20 in. between cars passing each other. The minimum distance between outer rails and curb is 3.28 ft. The track is divided as follows on the Neuhausen and Breitelinie lines, respectively: Straight track, 53 per cent. and 66 per cent., curved track, 47 per cent. and 34 per cent.

The Neuhausen line climbs a 5.4 per cent. grade on the way to Oberthor and a 4.6 per cent. grade between the steam railroad crossing and Scheidegg. The Breitelinie route has a maximum grade of 8.1 per cent.

All of the lines run on the public highway, and as the railheads are flush with the street, wagon traffic suffers no interference. The rails are laid on a foundation made up of large stones covered by rubble.

The track joints are made by mitering in a way common in Germany, milling out a portion of the head of the rail each side of the joint and extending the top of the outer angle bar so that it fits into the milled section and carries part of the weight from the wheel. Edison-Brown plastic bonds are used throughout.

The car barn, which has a capacity of twelve cars, is constructed of brick with skylights and wood and cement roof. It has two pits and four trucks, and is lighted by four arc lamps and ten incandescent lamps. A smithy and repair shop adjoin the car barn. The repair shop contains two lathes, planing machine, boring machine and grindstone. All of the machines are operated through belting by a 2-hp Oerlikon motor.

The line voltage is 550 and the drop is not permitted to exceed 50 volts. Current is transmitted by buried cables from two motor-generator sets located in the lower power station. One of these sets is always held in reserve. The motors receive current either from the upper station or from the reserve generator in the lower station.

The twelve-pole motors of these sets are built for 150 hp at 490 r.p.m., using 2,000-volt, three-phase current at 50 cycles. Each motor is connected to the corresponding direct-current generator by a flexible coupling. Each dynamo generates 182 amp. direct current at 550 volts.

All the trolley poles are constructed of steel. The power wire is made of hard-drawn copper 8 mm. thick and is supported by 6 mm. steel span wires 20 ft. above the rails. Return is made to the power station through the rails. The lines are protected by lightning arresters mounted on poles, and an automatic arc extinguisher where the feeders leave the power station. Steel guard wires have been placed parallel to the power wire to prevent contact with falling telephone or telegraph wires. These additional wires are attached to a 6-mm. copper wire connected to the rails.

The rolling stock consists of nine single-truck motor cars, one sanding car and one repair car. The mechanical part of the motor cars was built by the Schweizerischen Industriegesellschaft, of Neuhausen. The motors can be inspected from the top by lifting a portion of the car floor.

Each car has two 24-hp motors made with a close-fitting steel frame. The laminated poles are screwed to the inside of the frame. The frame is divided into two parts and may be opened either from the top or bottom, making all parts easy of access. Current is taken through four collector brushes. These brushes are so placed that they may be quickly removed from above even when the motor is mounted for service.

The armature has 37 slots containing 36 wires triple-covered with silk and varnished. The four poles, which are connected in series, have 200 turns of wire each.

The motors are series-coupled when running slowly, and parallel-coupled at high speeds and heavy loads. For control there are four series, six parallel and six braking positions. One of the motors can be cut out of circuit by lifting a contact on the reversing handle without interfering with the running and braking of the car. All of the controller contact fingers are furnished with arc extinguishers. The total cost of the street railway system was $112,000 (561,060.4 francs), or $23,000 per mile. The total number of passengers during 1901 was 481,143, or 6.5 per trip. To carry this traffic required 131,541 kw-hours. Fares are paid according to the zone system, the first zone costing 2 cents and 1 cent for additional zones. The highest fare possible is 5 cents. Reduced-fare tickets are sold to school children and workmen. Passes are granted to employees of the railway.

The operation of the system (exclusive of power stations) requires the services of twenty-nine men, including a director, starter, cashier, two ticket agents, three shopmen, three trackmen, nine motormen and nine conductors.

Electrical Exposition at Warsaw.

An electrical exhibition will be held at Warsaw, Poland, this summer to which it may be to the advantage of American manufacturers to send exhibits, in view of the fact that it is believed locally that the current year has opened a period of great industrial activity, especially in the electrotechnical branch. Articles for exhibition will be admitted free of duty. It is hoped that the Russo-Japanese war may not distract public attention from the affair.

Proposed Experiments With X-rays and Radium.

BY EDWARD P. THOMPSON.

Before the advent of Röntgen rays, Sir John Lubbock, F.R.S., proved, by a long series of critical, varied and repeated experiments, that the invisible ultra-violet rays are perceived, in some manner or other, by the insignificant, yet highly interesting ant. For details of the apparatus and experiments see "Ants, Bees and Wasps," D. Appleton & Co., published in 1888. His experiments were based upon the dislike which ants, in their nests, have for light. Although they have no such feeling when out in search of food, yet if light is admitted to their nest they at once hurry about in search of dark corners, where they all congregate. If, for example, he uncovered one of the nests, and then placed an opaque substance over one portion, the ants invariably made the shaded portion their rendezvous. The ants likewise carried their pupæ and larvæ to the darkest portions of the nest. This characteristic was also a basis of operations.

His first experiments related to the ants' relative avoidance of visible light rays of different colors. In all these tests the violet and purple rays affected the ants much more strongly than the other colors employed. In a general sense the transmitted light of differently colored glasses appeared to act on ants in the same general order as it does on a photographic plate. Furthermore, they preferred the violet glass to the plain colorless glasses. In place of the latter solutions were tried, and tests involving equal temperatures were included, but the results remained the same. It is needless to say that Sir John Lubbock took every possible precaution and followed the strictest rules of scientific research.

Another series of experiments included ultra-violet rays, negatively. He had found that if the ants have to choose between the violet and other colored glasses, they always preferred one of the latter. Next he found that the effect of putting over the violet glass a layer either of sulphate of quinine or bisulphide of carbon (both of which are transparent to our eyes, but both of which cut off the ultra-violet rays), the effect was to make the violet glass seem to the ants as good a shelter as any of the other colors. Hence, this twofold result is strong evidence that ants perceive ultra-violet rays.

He then tried more positive experiments with a saturated solution of chrome alum and chromium chloride, as these are very opaque to the visible light rays, but transmit the ultra-violet rays. The results were very striking. It made that portion of their nest so dark that he could see nothing. By an apparent expedient for watching their movements, he found that the ants avoided the ultra-violet rays. Different species of ants and different ants of the same species but of different nests behaved in a similar manner.

Whether the ants actually see some new color or light, or feel or hear it is not certainly known; but that ants constitute a detector of the invisible portion of the spectrum beyond the violet appears conclusive to Sir John Lubbock.

I have no longer the facilities for making X-ray experiments, nor do I know if others have tested their effect upon ants; but I propose to the Carnegie Institution at Washington or to others who are experimenting in the field of ether vibrations or limits of vision in animals, to determine if ants are affected by X-rays.

The electrical engineer is not so much concerned about the physiology of ants as is the naturalist, but he is anxious to add more facts for assisting in arriving at a more exact knowledge of the nature of X-rays. So far, it is known that this form of radiant energy causes certain salts to fluoresce; and that it affects the photographic plate. Consequently, it is like the short wave length from a luminous source. It is at the same time, invisible to man, and is thus like either the very short or very long wave length. It is like a long wave length in its power of penetrating substances which are opaque to light. As the same wave could not be both long and short at the same time, there is no reason why it could not be a mixture of long and short waves or else some energy without waves. Until ants are experimented upon, therefore, there is a void in this department of the science of radiant energy. A short wave, or energy of the spectrum beyond the violet, troubles ants. Will these insects immediately run away from Röntgen rays?

Investigations should also include the recently discovered etheric radiations. As nine years have elapsed since Prof. Röntgen made his remarkable discovery, and although all conceivable tests have been made upon radiant energy, may we not perhaps say, "Go to the ant thou sluggard, consider her ways and be wise?"

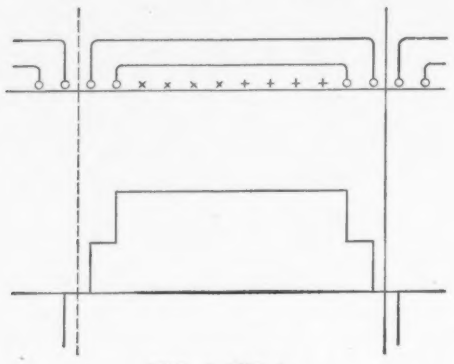
Calculation of the Equivalent Ampere-Turns of Windings for Single and Polyphase Currents.—II.

BY C. F. GUILBERT.

EQUIVALENT M.M.F. OF A SEPARATE PHASE WINDING.

CONSIDER first the common case of a polyphase winding where all sorts of the same phase are situated, for each pole, one following the other. It is evident that from the standpoint of the distribution of the inductive m.m.f. in the air-gap, the direction of current in the different conductors of each slot is only of interest; we can then group, by imaginary exterior connections, the conductors of different slots of the same phase in such a manner as to constitute a certain number of elementary coils per pole and per phase. In the present instance there are two cases depending upon the number of slots per pole and per phase.

Assume first the case of a winding of q phases with an even number, u, of slots per pole and per phase. Fig. 3 indicates that in this case we can form per pole and per phase $u/2$ elementary concentric coils of N/u turns, if N is the number of field conductors per pole and per phase. The m.m.f. distribution curve takes the form shown in Fig. 4. The angle between the axes of two neighboring slots being, for a bipolar machine, $\pi/q\,u$, the widest elementary coil will have the width



FIGS. 3 AND 4.

$$b = \frac{a}{\pi}\left(\frac{q\,u}{\pi} - 2\,\frac{\pi}{2\,q\,u}\right)$$

which gives for the quantity $\frac{b}{a}\frac{\pi}{2}$, $\frac{b}{a}\frac{\pi}{2} = \frac{\pi}{2} - \frac{\pi}{2\,q\,u}$.

The m.m.f. of this coil is, therefore,

$$fi' = \frac{4}{\pi^2}\cos\frac{\pi}{2\,q\,u}\frac{N}{u} I\sqrt{2}.$$

For the second coil we will have similarly for b and $\frac{b}{a}\frac{\pi}{2}$, the values

$$\frac{a}{\pi}\left(\pi - \frac{6\,\pi}{2\,q\,u}\right) \text{ and } \frac{\pi}{2} - \frac{3\,\pi}{2\,q\,u},$$

which lead, for this coil, to an equivalent m.m.f.,

$$fi'' = \frac{4}{\pi^2}\cos\frac{3\,\pi}{2\,q\,u}\frac{N}{u} I\sqrt{2}$$

and so on. Finally, the equivalent m.m.f. per pole and phase is $\mathfrak{F}_i = fi' + fi'' + fi''' + \ldots$

$$= \frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}}\,N I\sqrt{2}.$$

To obtain the equivalent m.m.f. for q phases, it is merely necessary to multiply the above by q, which finally gives for the equivalent m.m.f. per pole of a width carrying current I,

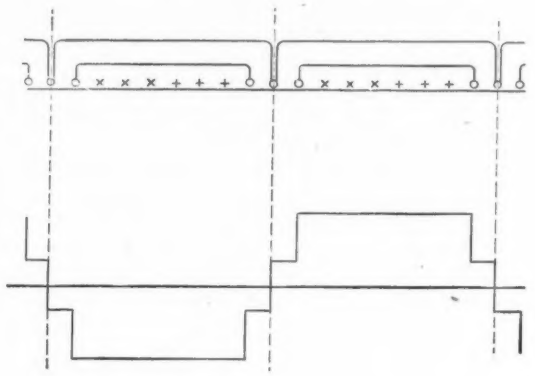
$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}}\,N I\sqrt{2}.$$

Suppose, now, that u is an odd number. With $u-1$ slots we can first form per pole $\frac{u-1}{2}$ elementary coils of $\frac{N}{u}$ turns, and then divide the last slot into two parts so as to form with the slots not utilized a coil of only $\frac{N}{2u}$ turns per pole. Figs. 5 and 6 represent diagrammatically the case for a three-phase alternator with three slots per pole and per phase.

The coil of $\frac{N}{2u}$ turns will have a width b' equal to the step, so that the equivalent m.m.f. will be $fi' = \frac{4}{\pi^2}\frac{N}{2u} I\sqrt{2}$. The widest coil with $\frac{N}{u}$ turns will have a width

$$b = \frac{a}{\pi}\left(\pi - 2\,\frac{\pi}{q\,u}\right)$$

since the angular distance between two slots referred to a bipolar machine is $\frac{\pi}{2u}$. We then have $\frac{b}{a}\frac{\pi}{2} = \frac{\pi}{2} - \frac{2\,\pi}{2\,q\,u}$, and consequently the equivalent m.m.f. of this coil is



FIGS. 5 AND 6.

$$fi'' = \frac{4}{\pi^2}\cos\frac{\pi}{q\,u}\,N I\sqrt{2}.$$

The narrowest coil, that of the order $\frac{u-1}{2}$ among the coils of $\frac{N}{u}$ turns, will, by analogy, have an equivalent m.m.f. equal to

$$\frac{4}{\pi^2}\cos\left(\frac{u-1}{2}\,\frac{\pi}{q\,u}\right)N I\sqrt{2}.$$

Summing up, as before, we have for a complete winding, per pole,

$$\mathfrak{F}_i = q \frac{2}{\pi^2} \frac{\sin \frac{\pi}{2q}}{u \sin \frac{\pi}{2qu}} N I \sqrt{2},$$

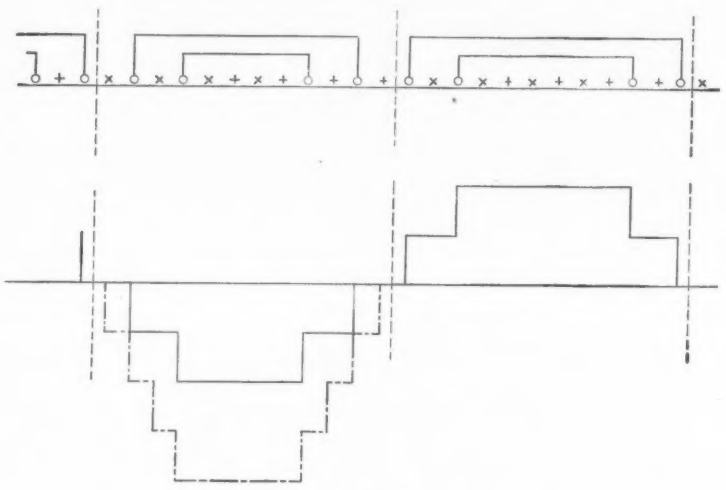
which is identical with the expression when u is an even number.

EQUIVALENT M.M.F. OF A SUPERPOSED PHASE WINDING.

We will now take up the case of superposed phase windings. This superposition can be regarded in two ways: First, that each slot contains only conductors of the same phase, in which case the slots of one phase are alternated with those of another phase; or that each slot contains an equal number of conductors of different phases. We will take up first windings with distinct slots.

Two cases are to be considered according as the number, u, of slots per pole and per phase are even or odd in number. Take first the case of an even number. As in the analogous case considered above, we can group the u slots of one phase and pole in two series of $\frac{u}{2}$ in such a manner as to constitute with a non-neighboring series and with the aid of imaginary connectors, one coil per pole formed of $\frac{u}{2}$ elementary coils placed concentrically (Fig. 7).

If we represent the m.m.f. due to a given current passing through



FIGS. 7 AND 8.

all the conductors of the phase considered, we obtain the distribution shown in Fig. 8. As will be seen, the m.m.f. of a phase is not the same for two neighboring poles. It is thus necessary in order to obtain the mean distribution of the m.m.f. per pole to take the arithmetical sum of the distribution curves under two neighboring poles and to divide the ordinates by 2, which is equivalent to using a double scale.

This summation having been made for the left side of the figure, it is easily seen that the result is as if there were per pole, in the phase considered, twice the number of slots, each of them being the seat of half the number of ampere-conductors. The value of the widths, b, of the elementary coils of a phase of a single pole are then, the angular distance between the two slots being $\frac{\pi}{2qu}$,

$$\frac{a}{\pi}\left(\pi - \frac{\pi}{qu}\right), \frac{a}{\pi}\left(\pi - \frac{\pi}{qu}\right) \ldots \ldots$$

$$\ldots \ldots \frac{a}{\pi}\left(\pi - (2u-1)\frac{\pi}{qu}\right)$$

We then deduce for the successive values of the quantity $\frac{b}{a}\frac{\pi}{2}$,

$$\frac{\pi}{2} - \frac{\pi}{2qu}, \quad \frac{\pi}{2} - \frac{3\pi}{2qu}, \quad \ldots \ldots \quad \frac{\pi}{2} - (2u-1)\frac{\pi}{2qu}.$$

If we always designate by N the number of conductors per pole and per phase, the number of turns of each elementary coil will here be $\frac{N}{2u}$, and the equivalent m.m.f. per pole will have for the phase considered,

$$\mathfrak{F}_i = \frac{4}{\pi^2}\frac{N}{2u} I \sqrt{2} \times$$

$$\left[\cos\frac{\pi}{2qu} + \cos\frac{3\pi}{2qu} + \ldots \cos(2u-1)\frac{\pi}{2qu}\right]$$

This sum has for value in applying the method used previously,

$$\mathfrak{F}_i = \frac{2}{\pi^2} \frac{\cos\left[\frac{\pi}{2qu} + (u-1)\frac{\pi}{2qu}\right] \sin u\frac{\pi}{2qu}}{\sin\frac{\pi}{2qu}} \cdot \frac{NI\sqrt{2}}{u} =$$

$$= \frac{2}{\pi^2} \frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}} NI\sqrt{2}.$$

Finally, we will have for the equivalent m.m.f. corresponding to q phases,

$$\mathfrak{F}i = q\frac{2}{\pi^2}\frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}} NI\sqrt{2}.$$

It is not without interest to compare the preceding formula with that which we established above for the case of windings by distinct phases. It will be seen that the expression for $\mathfrak{F}_i$ differs only by the factors

$$\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}} \text{ and } \frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}}.$$

These factors have the same value only when the number of phases is very great; that is to say, when the values $\frac{\pi}{q}$ and $\frac{\pi}{qu}$ are such that the sines can be replaced by arcs, when the expressions become equal to unity. In order to make a comparison with the normal values of q, suppose the number of slots is sufficiently large per pole and per phase that the sine can be replaced by the corresponding arc. We have then for the two factors,

$$\frac{\sin\frac{\pi}{2q}}{\frac{\pi}{2q}} \text{ and } \frac{\sin\frac{\pi}{q}}{\frac{\pi}{q}}, \text{ or } \frac{q}{\pi}\,2\sin\frac{\pi}{2q} \text{ and } \frac{q}{\pi}\sin\frac{\pi}{q}.$$

If we consider in particular the case of a three-phase winding $q = 3$

and the values are, for a factor $\frac{3}{\pi}$, $2\sin\frac{\pi}{6}$ and $\sin\frac{\pi}{3}$, or 1 and 0.866.

The employment of a superposed phase winding thus reduces the equivalent m.m.f. and consequently the field due to the corresponding winding, by 13 per cent. Superposed phase windings, which have been employed to obtain a distribution as close as possible to that of the sinusoid, thus lead in reality to a reduction of torque, and this is confirmed in practice.

On Turbo-Dynamos.--I.

BY PROF. DR. F. NIETHAMMER.

THE purpose of this paper is to outline the electrical and mechanical difficulties which arise in the design of turbo-dynamos (dynamo-electric generators directly connected to steam turbines) of 500 to 4,000 r.p.m. With all extra high-speed dynamos it is an easy problem to get a high-efficiency, a low-voltage drop, and, in the case of polyphase alternators, assure parallel running even with very variable loads consisting of synchronous motors or rotaries. The weight per kilowatt, the floor space per kilowatt (especially for types with vertical shaft), and the price per kilowatt may, without any difficulty, be kept pretty low, though by no means decreasing inversely proportional to the speed, since with high speeds the materials must be very carefully selected, while the shop work calls for special precision, involving increased labor cost.

The main difficulties in the design of turbo-dynamos are as follows:

(1) Satisfactory commutation to secure non-sparking in direct-current machines.

(2) Excessive heating, as the losses grow with the speed faster than the capability of radiating heat.

(3) High mechanical stress from centrifugal forces on rotating parts, their windings and insulation.

(4) Noiseless running.

It is certainly hazardous to guarantee the same degree of safety in service for turbo-dynamos as for the usual slow-speed, direct-connected dynamos. Any reduction of the speed of steam turbines to about half the value of present practice would be greatly welcomed by the electrical engineer, and the Curtis turbine seems to be a step in this direction. The difference in price would be trifling, as the materials would be cheaper and the wages lower for machines of larger size. A further trouble with these high speeds sometimes arises in three-phase plants of low periodicities. It is a well-known fact that turbo-alternators of 60 cycles can only be built for 3,600, 1,800, 1,200, 900, 600 and 500 r.p.m., and types of 25 periods only for 1,500, 750 and 500 r.p.m.; and in some cases the steam turbine has, therefore, necessitated quite abnormal periodicities. Turbo-alternators for less than 500 kw are rarely manufactured commercially, as they are impossible for small periodicities, neglecting the Laval turbine, since it works with a reduction gear.

In my opinion the rotating steam engine with rotating piston, instead of with reciprocating motion, is much more favorable for electrical work than the steam turbine. I have the following data on rotating steam engines of the Paschke system, which are built from 1 hp up to 10,000 hp and more:

5,000 hp, 250 to 420 r.p.m., as against 750 revolutions of the steam turbine; 4.3 kg. steam consumption for an indicated hp-hour. For 500 hp the speed is 250 to 610, against 1,500 to 2,500 for the steam turbine. It is, of course, necessary to gather further experience concerning this type in regular service.

There is an English patent, No. 6734 (1902) granted to Parsons, which tries to obviate the impossibility mentioned of building an alternator for 25 cycles directly connected to a steam turbine of 3,000 revolutions; but it is rather complicated and consists of two alternators, one of which has a rotating field directly connected to the steam turbine and outside of it an armature rotating with half the speed. This armature drives the field of the second alternator, the armature of which stands still.

(1) The difficulty of commutation for high-speed, direct-current machines is well known and has been discussed at much length. The fact is that some of the best-known electric concerns refuse to manufacture direct-connected, continuous-current turbo-dynamos. A more general use of steam turbines would thus lead to the exclusive adoption of a distribution system with polyphase central stations and sub-stations with rotaries. The excellent uniformity of speed of steam turbines would warrant in any case a very satisfactory service with rotaries even of 40 to 60 cycles.

Sparkless commutation is bound by the fundamental condition that the reactance voltage[1]

$$e_r = 4nLI$$

(where n = periodicity of commutation, L = coefficient of self-induction in henries, I = current in an armature circuit) shall be smaller than 2 to 3 volts at any load, or that the reactance voltage be continuously neutralized by a counter e.m.f. induced by an exterior field (field of commutation), either entirely or at least up to 2 or 3 volts. The high speeds naturally lead to a high value of

$$n = \frac{\textit{velocity of commutator}}{\textit{2 times thickness of a brush}}$$

and on account of the low voltage usually to a high value of the current, I, per armature circuit. Actual calculations on turbo-dyna-

FIG. 1.—PARSONS TWISTED TUBULAR CONDUCTORS.

mos of the best feasible design show reactance voltages of 5 to 15 volts. Without the help of an auxiliary commutation field, e_a, a sparkless commutation seems, therefore, to be next to impossible. A direct reduction of the reactance voltage can only be achieved by decreasing the coefficient of self-induction and the current, I, in an armature circuit. The first condition involves very narrow armature cores, large diameters and extremely high circumferential velocities; the second condition may be satisfied by splitting the type into several machines with proportionally reduced output, all on one shaft and connected in parallel. Somewhat less efficient is the method

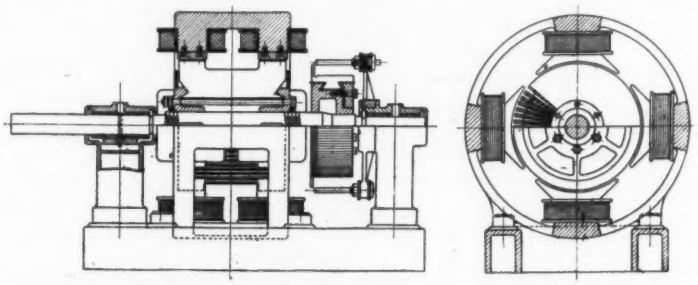


FIG. 2.—SCHÜTTDORFER METHOD OF BUILDING UP ARMATURE CORE.

of using one machine with several separate commutators. A low coefficient of self-induction is equivalent to a high resistance of the self-induced magnetic field round the short-circuited armature coils. Parsons proposes in his English patent, No. 5374, specially shaped, twisted tubular conductors on a smooth armature core (Fig. 1), to increase the magnetic resistance. For the same purpose the Schüttdorfer Maschinenfabrik builds up the armature core of iron sheets split in a radial direction not vertical to the shaft (Fig. 2).

The arrangement for neutralizing the reactance voltage, e_r, by an auxiliary counter e.m.f., e_a, are the following:

(a) *Automatic brush shifting.*
- α corresponding to the variable current (Thury, Parsons),
- β corresponding to the potential difference between the back (trailing) corner of the brushes and the commutator segments, (Fig. 3, Siemens Bros. English patent, No. 3777, 1903); in both cases the shifting is by a relay and an auxiliary motor.

(b) *Variable stray fields.*—Near the short-circuited armature

[1] Many of the points I can only mention here are more fully treated in the author's work, *Elektrische Machinen, Apparate und Anlagen (Enke)*.

coils between the pole tips, small auxiliary poles without winding are arranged, which divert a certain stray field from the main poles to the short-circuited coils. This stray field strength is varied according to the load by shifting these auxiliary poles in a radial or circumferential direction.

(*c*) *Auxiliary distributed field windings* shifted against the usual field winding by about half a pole pitch and excited by the main current (Ryan, Déri). This arrangement compensates also the armature reaction and allows the voltage to be reduced down to zero without sparking. Fig. 4 shows the cut of a direct-current turbo-dynamo with Déri winding built by the Austrian Union Company (330 kw, 650 volts, 3,000 revolutions; armature diameter = 520 mm., commutator diameter = 300 mm., air gap = 5 mm.). The compensating winding is imbedded into slots; opposite to the short-circuited arma-

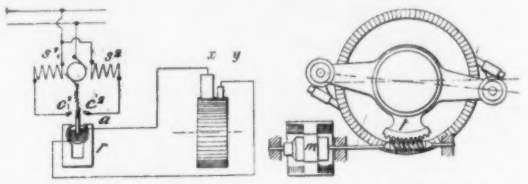


FIG. 3.—SIEMENS BRUSH AND SEGMENT ARRANGEMENT.

ture coils a specially broad commutation tooth directs the necessary commutation field on said coils.

(*d*) *Auxiliary poles excited by the main current* opposite to the short-circuited armature coils, either as a single-pole (Sautter, Harlé & Cie, Paris) or a two-pole (Siemens & Halske) arrangement.

(*e*) *Auxiliary Armature Windings.*—Between the main armature winding and the commutator a commutation winding is arranged which is either shifted towards the pole tips (Sayers) or induced by a special small field frame excited by the main current (Seidener); in each case the induced e.m.f. must act against the reactance voltage.

(*f*) *Spark-extinguishing blow-out devices,* acting either by compressed air (Thury) or by condensers switched between the commutator segments (Thury, German patent, No. 142,562).

(*g*) *Replacement of the commutator type* by the *unipolar* or *homopolar* machine, in which direct current is produced without any commutation. The main trouble is the fact that all existing unipolar types generate only very low voltages (50 volts and less) and that large eddy currents often occur. By using the most recent materials of exceptionally high mechanical resistivity, like nickel-steel, more satisfactory results may be expected.

(2) The *temperature rise, T,* in degrees Centigrade of a body

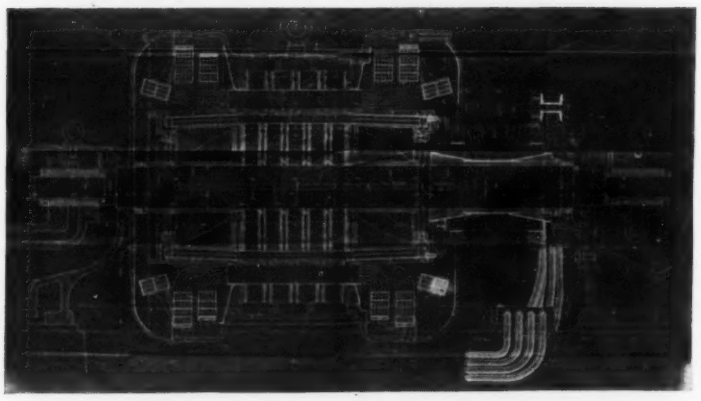


FIG. 4.—DIRECT-CURRENT TURBO-DYNAMO.

rotating at v meters per second and in which W watts are transformed into heat is approximately either

$$T = k \frac{W}{S\ (1 + 0.1\ v)}$$

or

$$T = k' \frac{W}{S\ (1 + 0.3\ \sqrt{v})}$$

where S = radiating surface in square centimeters and k and k' are constant.

If the speed of a given type is increased from v to $m\,v$, the voltage rises from e to e_1 volts. If the main current, I, remains the same for both speeds, the copper losses, W do not vary for both cases, but the iron losses, $W_h + W_e$ (hysteresis + eddy currents) grow to the value

$$m\,W_h + m^2 W_e.$$

The ratio of the temperature rise T_m (with $m\,v$) to T (with v) is, therefore, using the $\sqrt{v}$ formula, the best for wide variations of speed:

$$T_m : T = \frac{W_c + m\ W_h + m^2 W_e}{1 + 0.3\ \sqrt{m}\ \sqrt{v}} : \frac{W_c + W_h + W_e}{1 + 0.3\ \sqrt{v}}$$

This equation proves that with increasing values of m, that is with increasing speed or circumferential velocity, the temperature rise grows more and more and for a fixed maximum value of T_m there exists a certain speed, $m\,v$, for which W_c must be zero. That means for said high speed, $m\,v$, the machine cannot radiate any copper

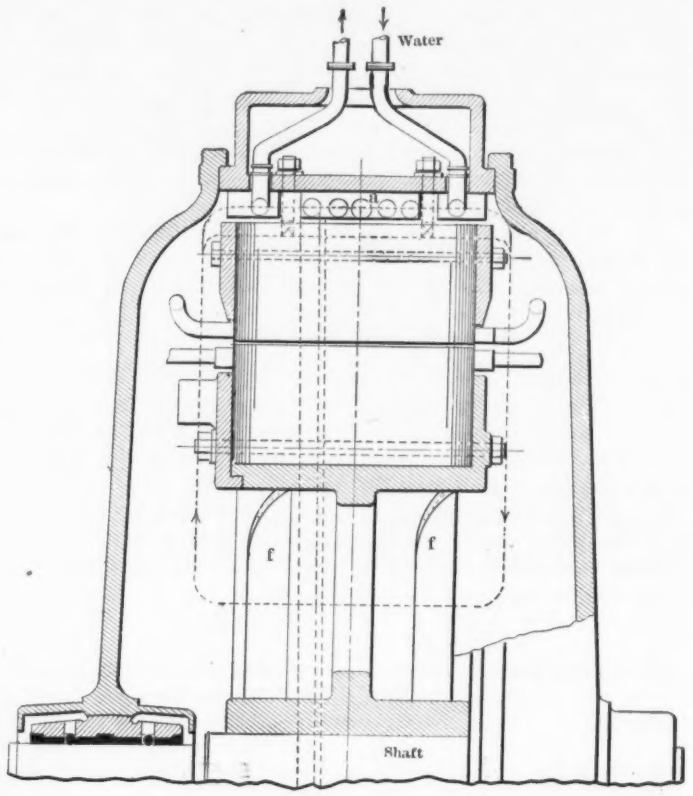


FIG. 5.—GENERATOR FRAME, WITH WATER-COOLING COILS.

losses, or the iron losses heat it to the very limit. In this case the dynamo delivers no useful work at all.

For high speeds especially nothing like an approximate proportionality between output and speed exists, which may be directly seen from the simple expression

$$T = \frac{k_1 + k_2 v + k_3 v^2}{S\ (1 + 0.3\ \sqrt{v})}$$

in which the total losses, W, are replaced by the sum of the copper losses, k_1, the hysteresis, $k_2 v$, and the eddy current, $k_3 v^2$, k_1, k_2 and k_3 being constants. Even in good design of low and moderate speed dynamos, $k_2 v + k_3 v^2$ is equal or larger than k_1, so much the more for high-speed machines, even of the very best design, the iron losses prove to be larger than the copper losses; that means, $k_1 + k_2 v + k_3 v^2$ grows faster with v than the denominator, $S\ (1 + 0.3\ \sqrt{v})$.

To keep the temperature rise sufficiently low, the iron section of turbo-dynamos in the induced parts must, therefore, be chosen as large as possible, and even especially thin iron sheets may be recommended in certain cases. In direct-current generators the radial iron depth is, however, very limited, as the outside diameter has to be small with regard to the high circumferential speed, and the inside diameter is fixed by the dimensions of the shaft. In the usual alternator design with rotating field, any radial iron depth is possible, but there are several drawbacks. The air-gaps diameters

being pretty small, the magnetic paths in the induced part become very unequal and the outside strips of the deep sheets grow more and more useless. Besides, the reduction of the iron losses is not proportional to the radial depth, but only about to the square root of it. The result of this reasoning is that the iron sections can usually only be made large enough by increasing the length of the machine. The capability of radiating heat, which decreases with growing speeds, must be artificially ameliorated by a great number of air ducts, in many cases ducts of 15 to 20 mm. breadth on an armature length of only 20 to 50 mm. The output coefficient $k = \frac{kw}{d^2 l\, n}$ (where d = air-gap diameter, l = axial length, n = r.p.m.) must be smaller than with slow-speed types in order to provide for sufficient radiating surface. Wing-shaped blades or even entire fans must often be attached to the rotating parts, diminishing somewhat the efficiency. A very rational means to reduce the dimensions, and especially also the high circumferential speeds, is in the use of water-cooling coils, *a*, wound into the generator frame (Fig. 5), while the air circulates round all the active parts moved by screw-shaped blades, *f*. In a more radical design (German patent, 96,532, by Schuckert) the cooling coils pass directly through the sheet iron of the induced parts.

A disagreeable addition of heating is very often experienced in high-speed generators by unforeseen eddy currents in the armature conductors, in hubs, flanges, bolts and pole shoes.

(3) High speeds necessitate also high circumferential velocities, v_p, of the journals in the bearings, viz., v_p = 10 to 15 meters per second, against 2 to 5 meters in usual designs. For a journal of the dimensions $d_p \times l_p$, the temperature rise is

$$T_p = C \frac{d_p\, l_p\, v_p{}^{3/2}}{\pi\, d_p\, l_p} = k^1 v_p{}^{3/2}$$

T_p grows with the 3/2 power of v_p This is the reason why most bearings of turbo-dynamos need artificial lubrication by oil under pressure or circulating water. All high-speed shafts must run absolutely true; the rotating field or armature must be carefully balanced, all the singular parts separately and totally, without and with windings. To avoid dangerous magnetic pulls, even in so-called compensated types (Ryan, Deri) the air-gap must be pretty large and the air-gap induction of moderate size.

Measurement of Internal Resistance of a Battery by Ohm's Method.

BY J. L. DICKSON.

AN interesting method of measuring the internal resistance of a closed-circuit battery is given below.

In Fig. 1, let G represent a galvanometer, R a variable resistance, K a switch for breaking the circuit, C a commutator for reversing the current by means of the plug P, and B a battery, the internal resistance of which is to be measured.

The apparatus is to be connected up in series as shown in the diagram, using short, heavy lead wires of negligible resistance for the connections. The plane of the galvanometer coils should be carefully set in the magnetic meridian, and the resistance of the galvanometer, if not known, determined by the Wheatstone bridge method.

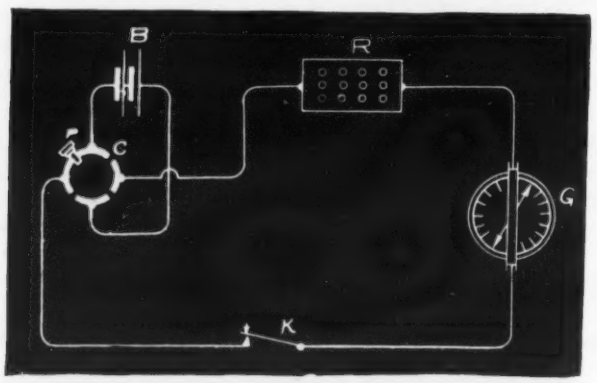


FIG. 1.—DIAGRAM OF CIRCUITS.

The resistance R is then so adjusted as to give an angle of deflection of about 40° on the galvanometer G. This deflection is to be recorded, then the current reversed through the galvanometer by means of the commutator C, and the deflection again noted. In reading the angle of deflection of the galvanometer both ends of the needle are to be read; the current is then reversed and both ends again read, and the average of all four readings taken as the angle of deflection. Enough more of the resistance R is then inserted to reduce the deflections by about 5° and the readings again taken as above. This is to be continued until the deflections are reduced to 20° or less.

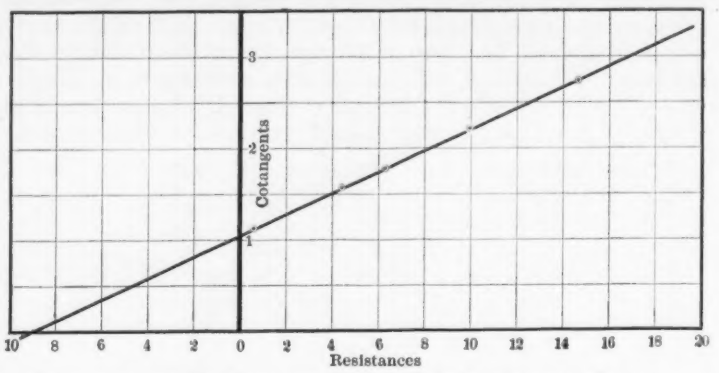


FIG. 2.—CURVES SHOWING RELATION BETWEEN RESISTANCES AND COTANGENTS.

Let us assume that during a certain test the following readings were obtained:

Resistance, Galvanom.	Resistance, Circuit.	Total Resistance.	Angle of Deflection. Position 1.	Position 2.	Position 3.	Position 4.	True Deflec.	Cotan. Deflec.
Ohm.	Ohm.	Ohm.	Deg.	Deg.	Deg.	Deg.		
.65	0.0	.65	40	39	43	43	41	1.15
.65	3.7	4.35	32	31	32	34	32	1.60
.65	5.7	6.35	29	28	30	31	29	1.80
.65	9.4	10.05	24	25	24	24	24	2.24
.65	13.9	14.55	20	19	20	19	20	2.74
.65	20.9	21.55	15	16	16	15	15	3.73

From the above readings let us plot a curve, using known resistance in circuit (adjustable resistance plus galvanometer resistance) as abscissæ and the reciprocals of the tangents of the angle of deflection as ordinates. The origin should represent zero values of both quantities.

The curve is found to be a straight line and shows that the resistances and cotangents of the angle of deflection bear a certain relation to one another; that is, as the resistances increase, so do the cotangents of the angles. This curve is continued as shown until it cuts the axis of abscissas, and the intercept on this axis represents the internal resistance of the battery, which in this case is found to be 8.9 ohms.

The interception of the straight line on the horizontal axis gives the internal resistance, because the external resistances were plotted on the other side of the zero point. Therefore, if this line is continued, it passes back of the zero, which is on the internal resistance side of the horizontal axis.

This method assumes a constant e.m.f. for the battery, and is not suitable for cells which polarize.

Electricity in Syria.

A recent United States consular report received at Washington from Syria says: "Recently the Beirut Gas Works, which has a ninety-nine year exclusive franchise from the Ottoman Government and first option on use of electricity, was purchased by Ibrahim Sabbag, a wealthy and enterprising Syrian, who is an honorary dragoman of this consulate. Mr. Sabbag is interested in securing the co-operation of American experts, being hopeful of extending the use of gas and eventually of electricity throughout Turkey in Asia. American electric fans have recently been admitted to Beirut, where quite a few have been sold during the past year. It is believed that electric street railways will be authorized by the Central Government before long, along with electric light, telephones, etc."

Standardizing of Subway Manhole Construction.

BY HUGH C. BAKER, JR.

ENGINEERS who have had experience in the construction of subways for telephone or electric light cables, especially in suburban districts, will readily appreciate the value of a system of manhole construction whereby all manholes can be built exactly the same in size and shape, with interchangeable concrete wall and top blocks which are placed together by ordinary laborers practically without supervision.

Such a system has now been designed and patented, and was used last year experimentally by the New York Telephone Company.

In Fig. 1 is shown a sectional elevation of a concrete block manhole which is believed to have points of sufficient merit to make it

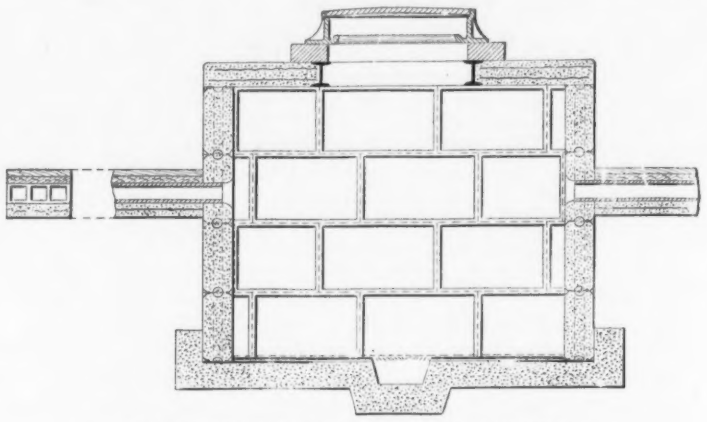


FIG. 1.—SECTIONAL ELEVATION OF MANHOLE.

a standard. The walls of the manhole are built up of separate horizontal layers or rings of concrete blocks of two different sizes and shapes—eight blocks to a ring, laid on a six-inch foundation of concrete. The four end wall blocks, exactly similar in size and shape, are adapted to be reversed or turned end for end in each separate layer so that all joints are broken, or staggered, as shown by the sectional elevation.

The blocks can be made any suitable height. In moulding, grooves are formed in the flat surfaces of the blocks (Figs. 1 and 4) prefer-

FIG. 2.—GENERAL VIEW OF BLOCK MANHOLE.

ably semi-circular in cross-section, as shown in Fig. 5. When the walls of the manhole are constructed, these grooves, coming together, form continuous open spaces, extending from top to bottom of the manhole, which are filled with liquid cementing material, forming mortar dowels between each block horizontally and vertically, as shown by Fig. 1. These dowels not only tend to lock the blocks in position, but will prevent water from passing through the joints.

The roof of the manhole is formed by sliding into position six flat concrete slabs, each about 5 inches thick, reinforced with expanded metal, or steel rods, and with beveled edges. The slabs bear on the flanges of the steel beams and on the walls. On completion, all exposed joints in the walls and roof are pointed with mortar, and the inside of the manhole is finished with a white cement wash to increase the light. The manhole illustrated, if properly constructed, should be absolutely impervious to water or gas.

The advantages of the block concrete manhole, compared to any previous method of construction, including monolithic concrete and brick construction, are that the blocks can be made in one place under proper supervision, in the winter time if necessary, shipped to the work, and laid up without skilled labor; and that there is very little, if any, waste of material. The duct entrance is made by breaking away portions of the blocks and filling in the opening around the ducts with concrete, using a small inside mould and outside boards to confine the free concrete to the shape of the walls.

Last year the New York Telephone Company constructed a large amount of subway in its suburban territory adjacent to New York City. More than one hundred sets of the concrete tops, about the same as illustrated in Figs. 1 and 3, were used on the ordinary brick

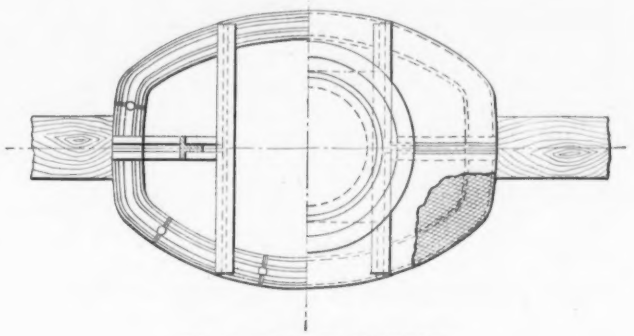


FIG. 3.—PLAN OF MANHOLE.

manholes with satisfactory results, and a number of the concrete block manholes were constructed, the blocks being without grooves and rectangular in cross section.

Fig. 2 illustrates one of the standard block manholes actually built in Rye, N. Y., where a railway bridge crossing was made with creosoted wooden conduit. All of the blocks were made in a large barn in Rye and shipped by wagon or rail to the different places where they were to be used. Over 1,200 blocks were made in the barn and only nine were broken in handling.

Portland cement concrete was used mixed in the proportion of 1-2-4, using three-quarter-inch machine-crushed trap-rock from the Connecticut quarries. The blocks were made in separate wooden molds and about five hours after mixing were placed in the open air to set from three to five days, before shipping. The average cost

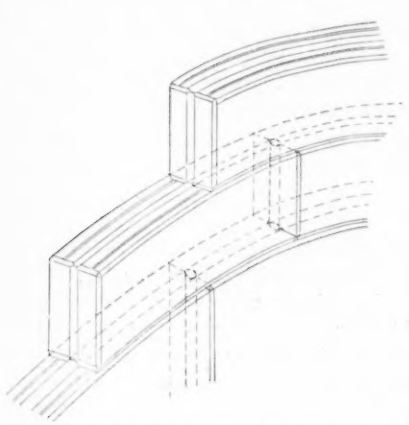


FIG. 4.—PART OF WALL SHOWING GROOVES.

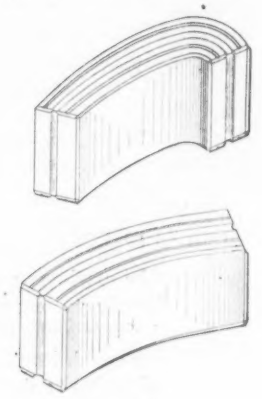


FIG. 4A.—WALL BLOCK SHOWING GROOVES.

of the block manholes constructed was found to be less than the cost of brick manholes of the same size and shape, and it was found that a block manhole could be constructed in about one-third of the time required to build a brick manhole. A concrete block manhole can be constructed, the iron cover set, the excavation filled in and the street opened for traffic in five hours by three men, under favorable conditions, whereas it usually takes a mason and helper with from three to four laborers one and one-half days to build a brick manhole of the same size.

The concrete blocks used last year were unnecessarily large and heavy, and time was lost in moulding in separate moulds. A new

form of mould has been designed, by means of which the required number of blocks for an entire manhole can be made in a small space in one operation, thereby greatly reducing the cost of manufacture.

The use of the block manholes in city streets is not always practicable, because of the presence of pipes and other obstructions. Under such conditions it is necessary to design each separate manhole to conform to the space available; and although a monolithic concrete manhole might be built instead of brick, it is less expensive to use brick, because of the high cost of building suitable interior moulds which are required in the construction of the monolithic concrete manholes.

For suburban work or the construction of long line subways on country roads, the concrete block manhole is without doubt the most economical and most suitable form of construction yet devised, and it is believed that a large number will be used in the immediate future.

A manhole has been designed built up of semi-hollow blocks which will probably be experimented with this year. The blocks when placed in the walls form vertical spaces through the walls similar to the construction of some of the concrete buildings which are now being erected in the Southern and Western States. It is not believed that the hollow blocks will be as universally suitable as the solid grooved blocks for manhole construction, however, because of the difficulty in making water-tight and gas-tight joints. The only object in using hollow, or semi-hollow, blocks would be to reduce the weight and the amount of concrete required.

Early References to the Mariner's Compass.

The following are the passages referred to by Brother Potamian in his introductory notice to the letter of Petrus Peregrinus on the magnet, which we printed last week:

Abbot Neckam (1157-1217) in his *De Naturis Rerum,* writes:

The sailors, moreover, as they sail over the sea, when in cloudy weather they can no longer profit by the light of the sun, or when the world is wrapped up in the darkness of the shades of night and they are ignorant to what point their ship's course is directed, these mariners touch the lodestone with a needle, which (the needle) is whirled round in a circle until when its motion ceases, its point looks direct to the north. (*Cuspis ipsius septentrionalem plagam respiciat.*)

In his *De Utensilibus,* we read;

Among other stores of a ship there must be a needle mounted on a support (*habeat etiam acum jaculo superpositam*) which will oscillate and turn until the point looks to the north, and the sailors will thus know how to direct their course when the pole star is concealed through the troubled state of the atmosphere."[1]

Alexander Neckam was born at St. Albans in 1157, joined the Augustinian Order and taught in the University of Paris from 1180 to 1187, after which he returned to England to take charge of a College of his Order at Dunstable. He was elected Abbot of Cirencester in 1213 and died at Kemsey, near Worcester, in 1217.

Guyot de Provins' satirical poem, written about 1208, contains the following passage:

The mariners employ an art which cannot deceive,
By the property of the lodestone.
An ugly stone and brown,
To which iron joints itself willingly
They have; they attend to where it points
After they have applied a needle to it;
And they lay the latter on a straw
And put it simply in the water
Where the straw makes it float.
Then the point turns direct
To the star with such certainty
That no man will ever doubt it,
Nor will it ever go wrong.
When the sea is dark and hazy,
That one sees neither star nor moon,
Then they put a light by the needle
And have no fear of losing their way.
The point turns towards the star;
And the mariners are taught
To follow the right way.
It is an art which cannot fail.

Provins, from which Guyot took his surname, was a small town in the vicinity of Paris.

Cardinal Jacques de Vitry, in his *Historia Orientalis,* Cap 89, writes:

"An iron needle, after having been in contact with the lodestone, turns towards the north star, so that it is very necessary for those who navigate the seas."

Jacques de Vitry was born at Argenteuil, near Paris, joined the fourth crusade, became Bishop of Ptolemais, and died in Rome in 1244. He wrote his "Description of Palestine," which forms the first book of his *Historia Orientalis,* in the East, between 1215 and 1220.

Albertus Magnus (1200-1280) in his *De Mineralibus,* Lib. II., Tract. 3, Cap. 6, writes:

"It is the end of the lodestone which makes the iron that touched it turn to the north (*ad zoron*) and which is of use to mariners; but the other end of the needle turns towards the south (*ad aphron*)."

This illustrious Bavarian schoolman joined the Dominican Order in his youth, lectured to great audiences in Cologne, became Bishop of Ratisbonne in 1260, and died in 1280. Thomas Aquinas, the greatest of schoolmen, was among his pupils.

In the Spanish code of laws, begun in 1256, during the reign of Alfonso el Sabio, and known as *Las Siete Partidas,* we read:

"Just as mariners are guided during the night by the needle, which replaces for them the shores and pole star alike, by showing them the course to pursue both in fair weather and foul, so those who are called upon to advise the King must always be guided by a spirit of justice."

Brunetto Latini, in his *Trésor de toutes Choses,* 1260, writes:

"The sailors navigate the seas guided by the two stars called the tramontanes, and each of the two parts of the lodestone directs the end of the needle to the star to which that part itself turns." (The reverse is the case).

Brunetto Latini (1230-1294) was a man of great eminence in the thirteenth century; Dante was among his pupils at Florence. For political reasons, he removed to Paris, where he wrote his *Trésor* and also his *Tesoretto.* He visited Roger Bacon at Oxford about 1260.

In his treatise *De Contemplatione,* begun in 1272, Raymond Lully writes:

"As the needle, after having touched the lodestone, turns to the north, so the mariners' needle (*acus nautica*) directs them over the sea."

Lully was born at Palma in the Island of Majorca in 1236; he joined the Third Order of St. Francis, dying in 1315.

Ristoro d'Arezzo, in his *Libro della Composizione del Mundo,* written in 1282, has the following:

"Besides this, there is the needle which guides the mariner, and which is itself directed by the star called the tramontane."

The following metrical translation of a poem by Guido Guinicelli, an Italian priest, 1276, we take from Bauer's "Principal Facts Relating to the Earth's Magnetism," 1902:

In what strange regions 'neath the polar star
May the great hills of massy lodestone rise,
Virtue imparting to the ambient air
To draw the stubborn iron; while afar
From that same stone, the hidden virtue flies
To turn the quivering needle to the Bear
In splendor blazing in the Northern skies.

The above extracts show that the directive property of the magnetic needle was well known in England, France, Germany, Spain and Italy in the thirteenth century. In the passage from Neckam, the *acum jaculo superpositam* has been construed by some to mean a form of pivoted needle, while in the letter of Peregrinus, 1269, which will appear in our next issue, the double pivoted form is clearly described. In this connection it will be interesting to note that the Dent Brothers, of London, have adopted in some of their ships' compasses this very mode of suspension on account of the damping effect which it exercises on the swing of the magnet.

[1] The Chronicles and Memoirs of Great Britain and Ireland during the Middle Ages, by Thomas Wright (1863).

High-Tension Work.

The March meeting of the American Institute of Electrical Engineers will be devoted to a discussion of subjects relating to high-tension work, which will be introduced by a number of papers serving as a framework for the discussion, to which all members are invited to contribute. Below are given abstracts of these papers:

THE RELATIVE FIRE RISK OF OIL AND AIR-BLAST TRANSFORMERS.

In opening the author, Mr. E. W. Rice, Jr., says that two types of transformers have been extensively used in electrical installations up to date, distinguished by the method of insulation and cooling employed. The "oil transformer" relies upon oil as the cooling and insulating fluid. The "air-blast transformer" contains insulation material mainly of cloth, paper and wood impregnated with oil or varnish, and is cooled by the circulation of a blast of air. In both types the insulating material is of an inflammable nature and under certain abnormal conditions may take fire with more or less serious consequences.

The electrical engineer must, therefore, consider carefully not only the relative but the actual fire hazard which exists, and by proper and common-sense methods minimize such danger. Both types can be made entirely safe by correct methods of design and installation.

It will be admitted that in general that type which contains the greater quantity of inflammable material will occasion the greater fire hazard. The inflammable material in an air-blast transformer of say 1,000-kw capacity will amount to about 800 pounds, in an oil-cooled transformer of the same capacity the amount will be about 7,300 pounds. While this comparison cannot be taken as a measure of the relative fire risk, it is an indication to be considered, especially in view of the fluidity, the low temperature of ignition, and high calorific value of oil.

While the quantity of inflammable material in an air-blast transformer is, as stated, relatively small, it has an extended surface exposed to a large volume of air, and, therefore, if a fire starts from internal causes, such as short-circuit or extreme overload, is capable of rapid combustion. This combustion could be checked by shutting off the flow of air to a transformer by means of a diaphragm automatically closed by the melting of a fusible link, the fusible link so located as to be melted by the first contact with flame; a method similar to that employed for closing fire doors in buildings.

An oil-transformer properly cooled is probably not particularly subject to ignition of the oil from internal burn-outs or arcs. It is well known that oil is an excellent medium for the smothering of alternating arcs, and this principle is utilized in connection with oil switches.

The vapor above the oil may, however, be ignited by electrical discharges. Even in this case, while the quantity of combustible material is enormous, the surface exposed is relatively small. The principal fire hazard in an oil transformer is due to the large mass of inflammable liquid material which, under certain conditions, may become totally consumed. It becomes a special hazard in the case of fire from sources eternal to itself.

Considerations of fire cost, economy of space, simplicity, operating costs, etc., have resulted in placing transformers in the same room with switchboards and other apparatus, such as synchronous converters, motor-generators, etc. Under such conditions it would seem that the air-blast transformer constituted the lesser fire risk than the oil transformer, and would, therefore, be generally employed if the fire risk were the only consideration. The air-blast type, however, is limited in practice to pressures of about 30,000 to 35,000, as the static discharge which occurs at much higher pressures would in time break down the insulation. It is, therefore, necessary to employ oil insulation on the higher pressures now common.

The fire risk can be practically eliminated by placing such transformers in a room or rooms separated by suitable fire walls from the other part of the plant. This plan has already been proposed and introduced. An entirely separate building, subdivided again into suitable rooms, may be employed where the maximum of safety is demanded. Much may be done to limit the risk, even when the transformers are placed in the same room with other apparatus, by proper systems of piping for drainage of the oil away from the building, by placing the transformers in a depressed area of concrete arranged for rapid drainage, etc. Of course, any of the methods commonly employed for preventing, limiting or extinguishing oil fires may be properly employed.

THE USE OF GROUP SWITCHES IN LARGE POWER PLANTS.

Mr. L. B. Stillwell, in a paper with the above title, considers the group-switch system with particular reference to the plant of that system installed at the Manhattan power station in New York. In this plant two complete sets of main bus-bars are used. Switches are provided by means of which each of these sets may be divided into two independent sets of bus-bars to each of which four alternators and four groups of feeders may be connected. Eight group switches are provided, through each of which current is supplied to a set of auxiliary bus-bars, to which in turn the individual feeders are connected through their respective switches. One of the eight feeder groups is used to supply power to auxiliaries in the power house. The other seven groups supply power, respectively, to the seven sub-stations which receive power from this central source. All switches in the high-pressure alternating-current circuits are of the motor-operated oil type.

The arguments in favor of the group switch as used in the plant of the Manhattan Railway Company are as follows:

1. It affords an additional means of opening a feeder switch that fails to open its circuit, when operated for that purpose. The advantages of the group switch in respect to this function to-day appear materially less than they did five years ago, for the reason that the power-operated oil switch within the period named has demonstrated a high degree of reliability. However, it cannot be assumed that the feeder switch is invariably reliable, and, therefore, judgment of the weight of the argument in favor of the group switch, based upon its use as a reserve for the feeder switch, becomes a question of judgment of the chances of failure of the feeder switch on the one hand and the seriousness of total interruption of power supply on the other.

2. It affords means of reducing aggregate load upon the power house in case of necessity, more rapidly and otherwise less objectionably than the usual method of cutting off individual feeders. It will sometimes happen in the operation of a power plant that it becomes necessary suddenly to shut down one of the generating units. If the load carried at the time be such that the shutting down of the generator implies reduction of the external load, this can be accomplished most conveniently by operating one or two group switches.

3. Where duplicate main bus-bars are used it facilitates transfer of load from one set to the other, in case it becomes necessary suddenly in operation to make such transfer. As bus-bars and connections are now installed in our best plants, this necessity does not arise frequently; nevertheless, it is liable to occur, and obviously half a dozen group switches may be used to affect the transfer in much less time than would be required were five or six times that number of individual feeder switches used.

4. The grouping of the external feeder circuits in group units bearing a simple fixed relation to the generator units establishes a symmetry and proportion most useful to the operator, particularly in times of emergency. In the case of the plant under consideration, at times of full load, the power passing through each group switch is substantially equal to the output of one generating unit. This relation of course does not exist under partial loads, but under such loads it is not difficult usually to keep in service generating capacity exceeding the load by a margin sufficient to make it possible to shut down one generator without cutting off feeders; and in cases where this margin of capacity is not kept in service it is, nevertheless, a more speedy and certain operation to cut off the necessary number of groups of feeders than it would be to cut off a proportionate number of individual feeders.

The arguments against the group switch are as follows:

1. It introduces additional apparatus and, therefore, in itself increases the risk of interruption due to failure in switch insulation, etc. The successful operation of many plants, particularly in America, has been interfered with by the introduction of too much switch gear and too many safety devices, automatic and other; these additions in themselves being responsible in some cases for more trouble than they prevent; and it is to be noted that the group switch implies the auxiliary bus-bar. Here again it is impossible to dogmatize, for as the result of additional experience, the judgment of to-day may be reversed five years from now. Mr. Stillwell considers that if the group switch and the auxiliary bus-bars be reasonably well insulated and installed, the interruptions originating in this additional apparatus should be almost negligible in the case of such a plant as that to which his remarks refer.

2. The group switch and its bus-bars imply, of course, an increase of cost of the plant. In case of the Manhattan plant this increase is about 10 per cent. of the cost of the switch gear and measuring apparatus, and about four-tenths of 1 per cent. of the cost of the plant. To put it another way, the cost of the group switches and bus-bars for the plant approximates $20,000, and the annual cost, assuming this to be 10 per cent. of the investment costs is $2,000, which is about two-tenths of 1 per cent. of the annual cost of operating the entire plant, including sub-stations.

In the plants in which the feeder unit equals or exceeds the dynamo unit of power, the group switch, of course, disappears. In this case, however, it may still be advisable to use two feeder switches in series in order to avoid the necessity of shutting down the entire plant in case of the failure of a single feeder switch.

Obviously, also, there is no reason for attempting to use group switches in cases where the total number of feeders is small. For plants comparable in magnitude to the plant of the Manhattan Railway Company, using a very considerable number of feeders, the group switch is important and its use generally advisable.

OIL SWITCHES FOR HIGH PRESSURES.

Mr. E. M. Hewlett, in a paper with the above title, compares the oil-break switch with the air-break switch. The following points are given as the main ones for consideration:

1. *Abnormal Rise in Pressure.*—Owing to the fact that in oil switches the circuit is opened at the zero point of the wave, the rise of pressure found in the air-break switch is not experienced. This point is of particular importance in high-pressure, long-distance lines, and in cables carrying considerable energy.

2. *Capacity.*—Experience has proved that oil switches may be designed to break circuits of practically unlimited capacity.

3. *Length of Arc.*—Owing to the smothering action of the oil on the arc the length of arc under oil is only a fraction of its length in air.

4. *Insulation.*—The insulating qualities of the oil decrease the distance required to prevent leakage and arcing.

5. *Size of Switch.*—Owing to the fact that the arc length is materially decreased and the value of the oil as an insulation reduces the creeping surface, an oil switch can be made very much more compact than an air switch.

6. *Remote Control.*—The design of the oil switch lends itself readily to operation by control from a distance.

7. *Arc Confined.*—The fact that the arc is ruptured under the oil within the switch has two advantages. First, switches can be placed close together without danger of short-circuit; second, in case of emergency, confusion is avoided as there is no visible arc to disconcert the attendant.

8. *Station Arrangement.*—The flexibility of the oil switch places no limitations on the station arrangement, permitting the circuits and busses to be arranged in the most advantageous manner.

9. *Isolation of Phases.*—The possibility of complete isolation of the phases in a reasonable space is easily secured by the use of oil switches.

TERMINALS AND BUSHINGS FOR HIGH-PRESSURE TRANSFORMERS.

Mr. Walter S. Moody, in a paper, considers the subjects of cables, straps, connectors, etc., for both high and low-tension side, designed both for terminal connections and for changes in the ratio of transformation, together with their insulation. In transformers for moderate pressure and having but two high and low-pressure terminals, the problem of terminals is a simple one; with higher pressures and numerous changes in the ratio, however, the design of these parts of the transformer often becomes a most difficult problem upon the proper solution of which depends, to no small extent, the reliability of the transformer.

It is much better to have the high and low-pressure terminals at opposite ends of the structure, for it is almost impossible to keep safe distances between the terminal and connecting coil leads, when all are at one end. In a shell-type structure, having its coils in vertical position, this requires one set of coil terminals to be at the bottom of the case, but to bring these safely to the top is not as difficult as to separate high and low-pressure conductors that are at the same end of the windings.

In an oil-immersed transformer the insulation of coil terminals presents little difficulty, as it is simply necessary to have all leads rigidly spaced a safe distance from each other and from the coils, and covered with sufficient water-proof insulation to prevent any moisture penetrating the coil around the terminals before the oil is put in.

In air-blast transformers, however, the case is different; here all terminals must be covered with an insulation integral with that on the coil itself, to a distance from the coil that provides sufficient surface insulation, even when the lead is well covered with dust and dirt.

Often the dielectric strength of a transformer is materially lowered by allowing the coil terminals or taps to project beyond the sides of the coils, thus shortening the distance between the primary and secondary. "Spreading" the exposed ends of the windings removes this difficulty, except when the terminal comes from a point well within the coil, but introduces a more serious defect, lack of rigidity to withstand the strains of short-circuits. Usually the problem can be solved by so winding coils as to have only outside terminals and locating such coils as have taps on the outside of the coil structure.

The best location for main terminals naturally varies with the type of transformer and its pressure; for the air-blast type, the air chamber forms a convenient and natural location for the low-pressure wiring, and the terminals of these are, therefore, usually located in the base of such transformers and made accessible by doors in the side of the base. For pressures not exceeding 25,000 volts, the high-pressure wiring can also be placed in the air chamber, without making the air chamber of excessive cross-section, so that all transformer terminals are in the base and exposed wiring is avoided. Heavy rubber-insulated cable is to be avoided in such construction, however, for should the rubber take fire from short-circuit or other causes a draft of air will carry the fire along the duct and into the transformers with great rapidity.

In oil-filled transformers the terminals are, of necessity, located at or near the top of the case. Often for convenience in external wiring projecting pockets are provided through which terminal leads may leave the case in a downward direction. With such construction, it is necessary to have a solid section in the cable, just above the oil line, and to have this section uninsulated or covered with an insulation impervious to oil, otherwise the cable and insulation will act as a syphon and discharge oil.

Below 40,000 volts the insulation of high-pressure terminals offers no special difficulty; porcelain or glass bushings can readily be obtained that are safe for this pressure, even if the conductor has no insulating covering. For higher pressures, the problem is more difficult, if no insulation is used on conductor, the bushings become expensive and so large that there is scarcely room on top of a moderate size transformer for as many terminals as are often required.

Some of the more common forms of bushings that have been used are wooden tubes, hard-rubber tubes, glass and porcelain tubes, both single and concentric, and numerous forms of molded porcelain bushings.

Wooden tubes of the necessary size cannot be thoroughly dried and filled. Hard rubber is so apt to contain impurities that it is unsatisfactory; moreover, it deteriorates rapidly if ozone is generated near it. Glass is fragile and must be protected with other semi insulators. Porcelain, or any smooth tube, must be very long if it have sufficient leakage surface to be safe when dirty, and even the best shapes of corrugated bushings are large and expensive when capable of withstanding a test of from 75,000 to 160,000 volts. All things considered, the following practice is quite satisfactory for test pressures not exceeding 160,000:

Insulate the lead with varnished wrappings that will safely withstand for one minute about half of the test pressure to be applied, bringing out this lead through a porcelain bushing having the same strength as the insulation of the lead, and sufficient surface to prevent leakage at this pressure when dirty; in other words, let the insulation of the leads be sufficient for the working pressure, and the porcelain be of such strength as to give the factor of safety desired. This combination forms a far safer insulation than a bare conductor and a larger bushing, which would stand the same puncture test as the combination, from the well-known fact that oxidized linseed oil is an insulation that will momentarily stand several times as much as it will for any considerable length of time, while porcelain, glass, etc., have no such time factor.

In leads requiring a test of 100,000 volts or more, and insulated in this manner, an additional difficulty is met in the induced charge on the outer surface of the insulation; at this pressure the surface is covered with a heavy brush discharge that so reduces the surface resistance to leakage that 100,000 volts will travel along several feet. It is usually impracticable to make the insulated lead long enough to withstand the pressure under these conditions, but the discharge may be broken up, so that it will not appreciably reduce the surface resist-

ance, by bell-shaped pieces of rubber, porcelain or other insulation slipped over the lead before all the varnished wrappings are put on, and having its small end so shaped as to allow of its being burned in the outer wrappings.

In transformers designed for Y-connection and grounded neutral, some transformer builders, in order to save expense on high-pressure bushings, have grounded one terminal on the case and insulated only; such leads as are to be connected to the line; this prevents operation with △ connections, but otherwise seems unobjectionable. In similar manner, the use of three-phase transformers with the interconnecting between the phases made within the case, reduces the expense and possibility of trouble with bushings.

Eighty thousand volts is the highest pressure that is now practicable for transmission work, but transformers and insulators must be tested, consequently there is some demand for transformers working up to 200,000 volts. The insulation of the terminals of such transformers is the most formidable part of their design. As yet there is no satisfactory solution of the problem except to use oil-filled tubes as terminals. A terminal that has withstood 375,000 volts without any indication of weakness is constructed as follows:

The tube was the shape of two truncated cones, bases together; about 12 in. in diameter at the center and 4 in. at either end; it was built up of thin wooden rings, telescoped a short distance into each other and held together by the conductor, which, for mechanical purposes was made quite heavy, and which was located in the axis of the cones and supported by washers at either end of the tube; between each section of the tube were collars of insulating material, some three inches larger in diameter, than the tube which served the purpose of greatly increasing the leakage surface. After the sections were drawn tightly together by nuts at each end of the conductor, the whole structure was repeatedly dipped in varnish and dried, thus sealing all joints. The terminal was mounted with the lower end several inches under the oil in the transformer and with its largest diameter on a level with the cover; the lower end of the tube was tightly sealed, making the tube perfectly oil-tight.

At present we are passing through a period of development in line construction. Each engineer of a new transmission system of considerable length desires to use as high pressure as possible with a line construction of reasonable cost, but few are sure whether 50, 60, 70 or 80,000 volts is the safe maximum for their conditions. It is common, therefore, for the manufacturers to be asked to make transformers that can be operated at several voltages on the high-pressure side. The result, whether accomplished with series-multiple connection, changing from △ to Y, or simply by taps, usually requires so many terminals that it becomes quite impracticable to place all the necessary leads outside of the case, even were it desirable to do so; consequently, accessible terminals inside the case must be provided. Again, at these and lower pressures, also, it is usually desirable to provide for limited range of adjustment in the ratio, say, by 2 per cent., with a total of 10 per cent.; such changes are usually too small to be made except by means of taps on the high-pressure windings.

Except to transformers of very large capacity, there would be no room safely to insulate so numerous terminals above the surface of the oil; the practice is, therefore, to locate such terminals just under the oil and make them as accessible as possible, either by the removal of the transformer top or through an auxiliary cover on the top of the case. It is better that each of these terminals be separately supported by glass or porcelain insulators, for a single support, such as a slab of marble, is almost sure to collect sufficient semi-conducting material to cause trouble sooner or later. Such terminals being, at the best, rather inaccessible there is danger that a wrong or imperfect connection will be made when changes are desired; the following method of mounting transformers in the tank greatly simplifies the problem of getting at such terminals, especially when transformers are installed under a crane. Instead of supporting the transformer proper on the base of the case as usual, it is hung from a strong cover; the interior terminals are placed in about the usual position, but are supported by the bolts carrying the transformer. To get at these terminals it is then simply necessary to raise the cover with the transformer, until the terminals are on a level with the top of the case; connections may then be made with convenience and safety and the transformer returned to its position in the tank.

Usually low-pressure terminals present no special difficulties; when transformers are connected in multiple and deliver 500 amp. or more, special caution should be taken that all joints are soldered or that terminals are of such construction as to have extremely low contact resistances. Taper plugs and receptacles are perhaps the most reliable form of contact for the purpose.

Current in excess of 500 amp. should never be brought out through separate openings in the case, otherwise there will be local heating around the terminal and needless reactance introduced into the circuit. Currents over 2,500 amp. should be brought out by means of intermixed bus-bars for the same reason.

The Ward Leonard Oerlikon Locomotive.

We publish herewith three interesting photographs showing the Ward Leonard Oerlikon locomotive in actual operation. The practical tests of this locomotive began the first week in February, the

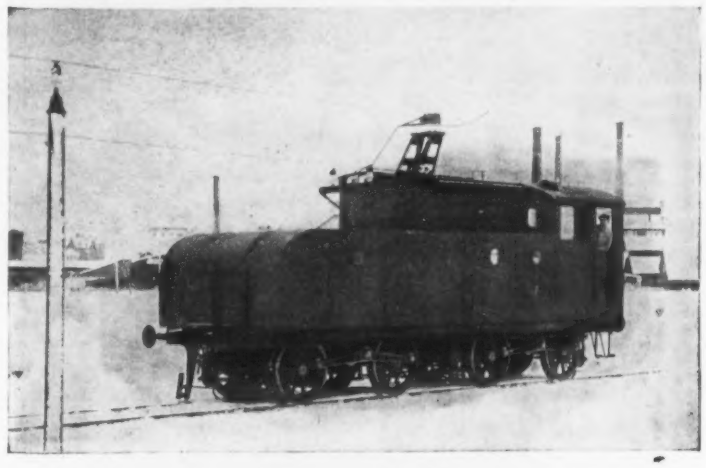


FIG. 1.—GENERAL VIEW OF LOCOMOTIVE.

tests being made in the presence of a Swiss government committee appointed for the purpose of investigating the locomotive. The entire control of the locomotive in starting, accelerating, varying the speed, braking electrically, stopping and reversing was accomplished in

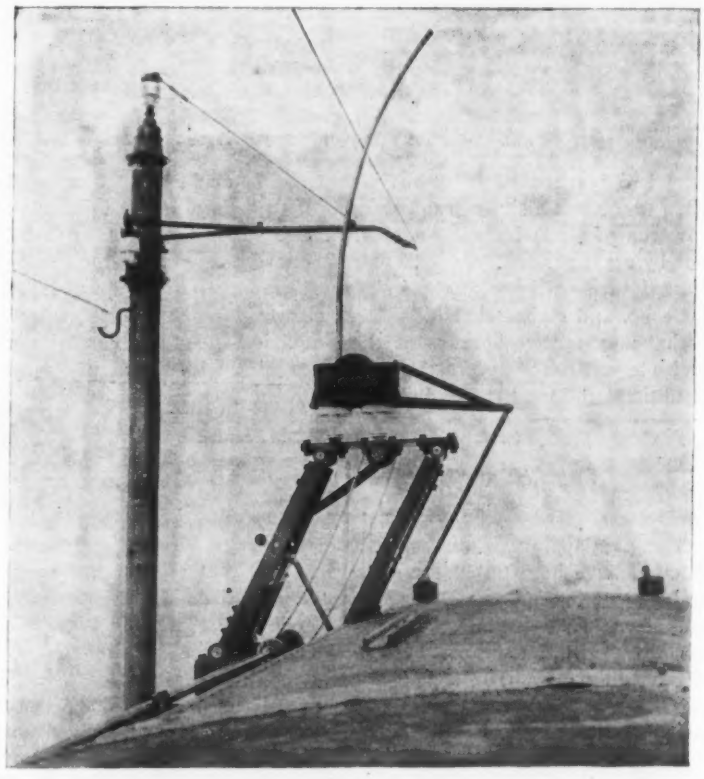


FIG. 2.—CURRENT-COLLECTING DEVICE ON TOP OF CAB.

the most satisfactory manner by a single controlling hand wheel, which controls the small current required for exciting the field of the generator. The experiments were conducted with a single-phase current of 13,000 volts. As a result of these satisfactory trials the Oerlikon Company arranged to extend its private experimental line

to the Seebach station, which is one terminus of the State Railway to be equipped with the Ward Leonard system by the Oerlikon Company in connection with the State Railway authorities.

Mr. Leonard has called our attention to a typographical error which occurred in his article published in our issue of February 27. Mr. Leonard had stated that the horse-power of modern steam locomotives had reached 1,750 hp and that two of such locomotives were often used upon a single train, showing that modern practice demands upwards of 3,000 hp upon a single train. This figure of 1,750 hp was by error printed "175 hp." Mr. Leonard believes that the immediate future will see single freight trains operated by upwards of 5,000 hp, and claims that his system presents unique advantages for such heavy service because of the simplicity and perfection of the multiple control of several locomotives, which will divide, under all conditions, the total tractive effort demanded by such a train.

FIG. 3.—SIDE VIEW OF LOCOMOTIVE.

The Rivalry of Electricity and Steam.

The overlapping of the merits and claims of electric and steam traction have been noted for some time past, but they occupy more and more attention as the time goes by, and their struggles remind one of the early warfare waged on electric lighting by the advocates of gas. Within the past week the subject has been discussed by two leading organs of technical opinion, the *Railroad Gazette* and the *Street Railway Journal*, each authoritative in its own field. Both recognize the problems and difficulties of the situation, involved not only in a change of motive power, but in a necessary readjustment of conditions in many other respects. The *Street Railway Journal* regards the conditions as a deadlock, and says: "The flank movement executed by the railroads in securing important links in the electric railway network is a very adroit one, and will certainly block the union of interurban lines for through business in numerous instances. As a matter of public policy this attack must be in some way met, but it is rather difficult to settle on a course of action which will be both effective and unobjectionable. The general interests of the community are served by an increase in the facilities for transportation, and the fact that such an increase will injure somebody's previous monopoly of them is not a thing that should be considered any more than the introduction of improved machinery should be hindered, because it destroys the monopoly secured by an earlier patent. But whatever steps are taken to prevent the crippling of the development of interurban roads must be taken cautiously and without prejudice or malice." It also remarks: "We believe it is within bounds to say that upon the whole the electric roads operated by steam railroad companies are among the very best of the interurban class. Their managers bring to the work of construction and operation the best precedents of railroad practice, too often neglected by the independent roads, and the general results are worthy of high commendation. But for the full development of the usefulness of electric traction, so far as the public is concerned, and for the maintenance of earning capacity it is highly desirable that interurban lines, now generally run in a very heterogeneous fashion, should work in harmony and deal with through traffic of the less important kind at least. What is the use of having great electric railway networks, covering scores of hundreds of miles, if they cannot be fully utilized for want of proper management? The managers of interurban lines are rapidly finding out that through cars are a paying part of the equipment, and that it pays to use connections instead of disregarding them. Now, these connected systems, when properly operated, give to the public much better service than is generally given by the steam lines which cover more or less thoroughly the same territory, and are, therefore, competitors in the proper sense of the term. What shall be done about through connections in case the steam system acquires, by hook or by crook, one of the essential links in the electric interurban network?"

Turning to the *Railroad Gazette*, we find there a significant editorial discussion of the purchase of the trolley network at New Haven, Conn., by the New York, New Haven & Hartford Railroad Company, and, considering it under two aspects, physical and local, of President Mellen's policy in this move, it says: "He is prompted, no doubt, immediately by the threatened electric parallels of which two links are already built and two projected. There is nothing, it is true, to prevent absolutely such an extensive line from "looping" a city like New Haven in its advance toward New York City. But the physical obstacle is considerable, a cross-country line is bare of local business, and the tapping of important cities is vital to its success as both an immediate and remote competition. There are other questions which such a large purchase by a steam railroad corporation raises. For example, what is the policy of a steam company as the owner of both the steam and trolley competitors? Will the steam or the electric rivalry give way? The answer in terms of corporative common sense as well as of public interest is ready at hand. The electric traffic must be favored and the steam service reduced, the loss by the latter being of relatively small import so long as the receipts of both go to the same corporative pocket. To a second query the answer is more obscure. In the wholesale purchase of urban systems to block long-distance parallels, what will be the policy of legislatures toward long-distance lines with reference to the right of urban entry —either independently or over the purchased system under control of hostile interests? Hitherto, in general, the entrance of outside lines on unified urban street railway systems has had to be obtained by special contract and concessions, and even when there are general railroad statutes on the subject they are apt to be evaded in spirit and practice by the urban monopoly, whether steam or electric. Will such a policy give us a new and more drastic direction of law-making on interchanges of electric traffic? That it will at least promote some acute legislative controversy seems pretty certain.

"In more general phases still the New Haven precedent has large meanings. Experience has shown clearly at the west that direct interurban competition by the old steam companies with electric lines has been futile. But here is a new proposition: For competition by operation has been substituted the new method of competition by purchase, using the word "competition" here in its broadest sense to include prospective rivalry. The method, should it ever become generally accepted, introduces us to an entirely new set of theorems bearing on the relations of steam and trolley. Beyond lie even larger potentialities, such as bringing nearer the period when, with the great steam railroads operated with electric locomotives, and owning large urban street railway systems, the electric car, for purposes of local traffic, may duplicate service on the city street and the electrified steam line. It is not very remote, and the Fair Haven & Westville sale is one of the striking events that nods towards it."

One of the Groups in the Power Plant of the World's Fair.

BY THOMAS M. MOORE, CHIEF DEPT. MACHINERY.

The accompanying plan shows the arrangement of machinery in one of the sections of the Exhibitors' Power Plant of the St. Louis World's Fair. By reference to the installation plan for Machinery Hall, which accompanies this, and by reference to Block No. 36 thereon, it will be discovered what relation this particular block holds when compared with the total, for it must be borne in mind that the entire western half of Machinery Hall—that is, all the blocks from No. 36 to No. 53, inclusive—are devoted to prime-movers and accessories and the power plant of the Exposition.

The elements to be found in Block No. 36 are as follows: The principal unit, located in the center of the space, is a 5,000-hp Allis-Chalmers engine of the same type as the engines to be found in the Manhattan Elevated Railway power station in New York City. It is a compound condensing engine with a horizontal high-pressure cylinder (44 x 60-in.), and a vertical low-pressure cylinder (94 x 60-in.). Directly connected to it is a Bullock 3,500-kw, 6,600-volt, 25-cycle alternator. The normal revolutions are 75 per minute, and the current generated will be availed of for general lighting and power purposes.

The smaller engine is an A. L. Ide & Sons compound, with cylinders 13 and 26 in. in diameter x 18 in. stroke. Directly connected to this engine is a 200-kw, 250-volt, direct-current Bullock generator. About one-fourth of this energy is availed of for the excitation of the large Bullock alternator, and the remainder—about 150 kw—is passed through a balancer set and delivers multivoltage to motors driving machine tools exhibited in Machinery Hall, and operated by the Bullock multivoltage system.

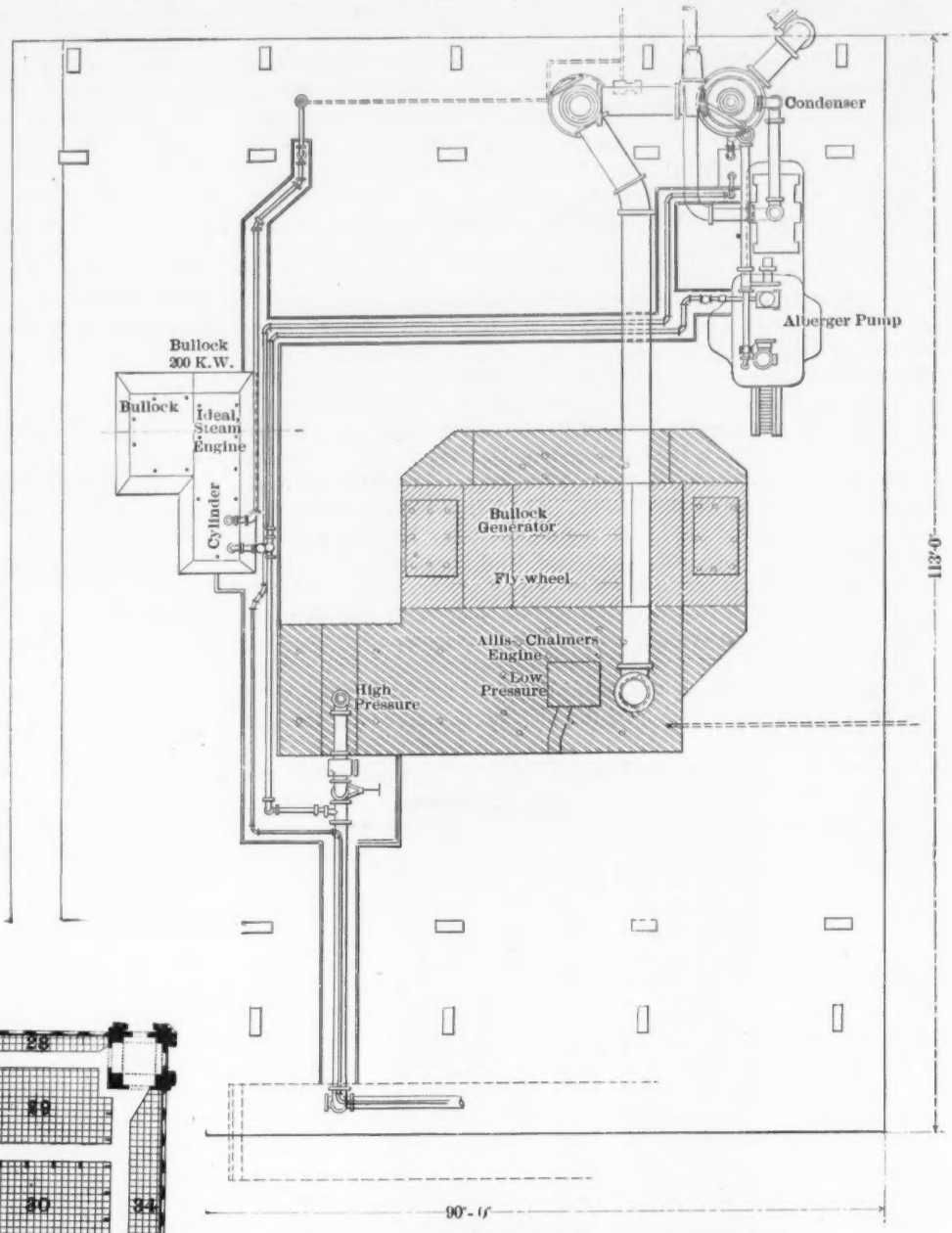


FIG. 2.—PLAN OF POWER EXHIBIT AT ST. LOUIS FAIR.

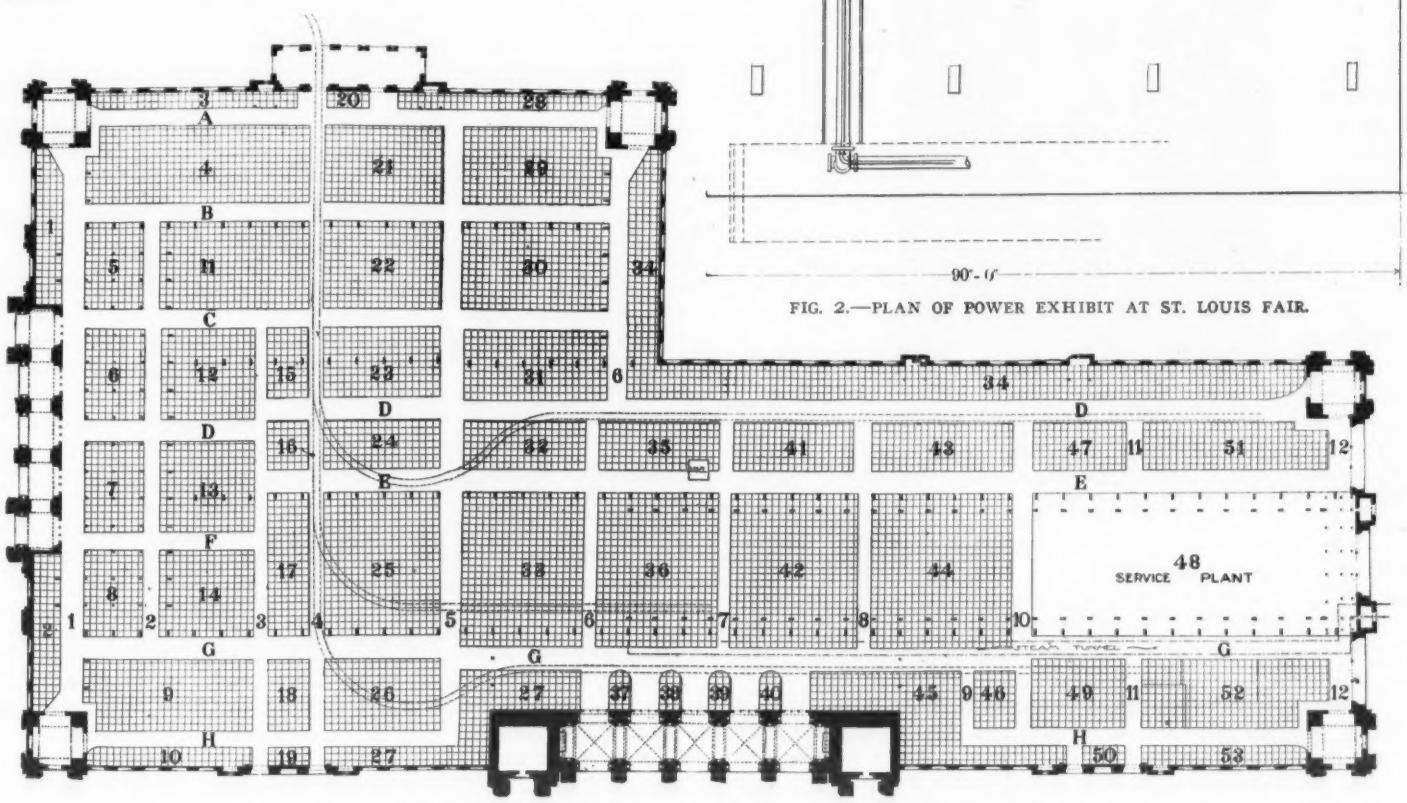


FIG. 1.—INSTALLATION PLAN MACHINERY HALL, ST. LOUIS FAIR.

The steam for these engines is generated in the Steam, Gas and Fuels Building, located about 100 feet west of Machinery Hall, and the group of boilers furnishing this steam is approximately 750 feet distant from the engine installation. The steam is delivered at 150 pounds pressure at the throttles.

The condensation of the exhaust steam is taken care of by exhibits from the Alberger Condenser Company, of New York. The apparatus consists of a 36-in. barometric tube type condenser with air cooler and tail pipe complete and a combination vertical Corliss engine-driven vacuum-pump and a rotary circulating-pump. The condenser cone is elevated 55 feet above floor level. The steam traps, steam separators, oil separator and exhaust heads are ex-

hibited by the Steam Appliance Company of Milwaukee, Wis. The pumps exhibited by the Morris Machine Works, of Baldwinsville, N. Y., and the Deming Company, of Salem, O., take care of, respectively, the return water and the freeing of the oil separator.

The total installation is rapidly approaching completion, and if nothing now unforeseen prevents the plant will be ready for operation by or about the first of April. The erection of the machinery has been effected by the 60-ton traveling crane, with a 5-ton auxiliary, built and exhibited by the Shaw Electric Crane Company, of Muskegon, Mich. The heaviest piece in this installation weighs 83 tons and this was handled with the utmost ease by the Shaw crane.

New Telephone Patents.

THE REPEATER AGAIN.

Still another repeater has come to light, this time described in a patent issued to S. P. Levenberg, of New York City. This is shown in section in Fig. 1. It will be noted that the microphone part is not in the usual position with reference to the diaphragm of the receiving part, but is located with its electrodes in a plane perpendicular to that of the diaphragm. The diaphragm is not rigidly secured, but lies upon the top of a hard rubber annulus. Projecting from this annulus in a downward direction, at opposite extremities of a diameter, are two lugs of sheet metal. The left-hand one, as shown in the cut, is secured to the frame of the instrument by screws passing through its lower end, while the right-hand one is secured directly to the movable electrode of the transmitting button. The diaphragm is, of course, capable of taking two sorts of motion—a vibration confined to itself and a swinging motion about the hinging lug.

It is the idea of the inventor that this latter motion will produce an effect upon the transmitter far in excess of anything which could be produced by direct action of the diaphragm. However, the bulk

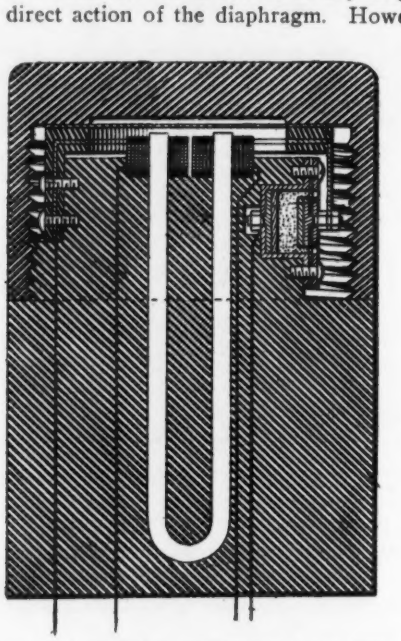


FIG. 1.—LEVENBERG TELEPHONE REPEATER.

of the moving parts will surely introduce a sluggishness of action quite fatal to the quality of the repeated tone.

NEW RELAYS.

Mr. H. P. Claussen, of Chicago, has produced a new relay for telephone signal work which embodies most novel means for preventing sticking of the armature due to incipient welding of the contact to its anvil. Considerable trouble is at times experienced from this cause, especially where a condenser of a high capacity line or apparatus is in the controlled circuit. The new relay in question is of the double-bobbin type, much in appearance like an ordinary telegraph relay of which the plane of the coils has been turned parallel to that of the direction of armature swing. The usual adjustable screw stop and adjustable contact screw of this telegraph relay are provided, supported from a frame to which the bobbins are secured. Upon the rear of the armature is secured a slip spring riveted near the middle of the armature. One end of this is engaged by an adjustable screw and secondly the metal crown would apparently be almost as good spring carries the contact anvil, which is placed on the side of the spring nearest the armature and opposite an aperture in this latter. Thus, when the armature comes up for contact, the contact screw passes clear through it without resistance, and, striking the contact anvil, forces the spring away from the armature. When the current ceases the armature begins its backward travel and strikes a hammer blow upon the contact spring sufficient to break any weld which may have occurred.

Another new relay is one patented by M. C. Rorty, of Boston. This is a single-core relay with a return pole piece lying above the coil and serving as a hinge and support for an angular armature, after a well-known design. A novel feature is, however, the polarization of the relay by the mounting of a permanent magnet of U form with one pole clamped to the yoke end of the core of the bobbin, while the other pole confronts its free end. The design is such that a dust-proof cap of standard construction may be readily used, as may be seen from a glance at Fig. 2, which shows side views of both Mr. Claussen's and Mr. Rorty's relays. Of the two patents, that of the first-mentioned of these gentlemen has been assigned to the American

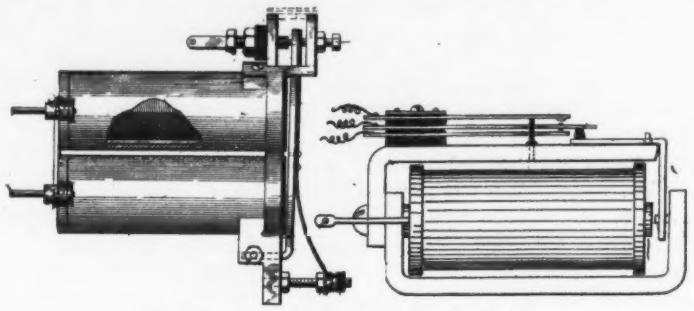


FIG. 2.—CLAUSSEN AND RORTY RELAYS.

Electric Telephone Company, while that of the latter is assigned to the American Telephone & Telegraph Company.

SOME NEW CIRCUIT ARRANGEMENTS.

Two patents for new circuit arrangements have been issued, the one to F. R. McBerty, of Evanston, Ill., relating to message-counting devices, and the second to E. H. Smythe, of Freeport, Ill., covering new connecting cord and trunk circuits. Both patents are assigned to the Western Electric Company.

It is Mr. McBerty's idea to so control the push-button type of message counter that it will be impossible for an operator to register a message before the called party has answered. It will be recalled that the type of counter in question is usually wired in parallel with the subscriber's cut-off relay, but is insensitive to the currents received in normal connection. To operate it a high current from an excessive source of potential must be thrown upon it by a push key under control of the operator. In the present case an electrically-controlled latch restrains this key until the controlling magnet is energized by the response of the called subscriber as indicated by his removing his receiver from the hook. From this time on a call may be registered, the latch being held from the key during the remainder of the connection.

Mr. Smythe's circuit includes extra switching devices in both trunk and connecting cord circuits, arranged to remove all grounds from the trunk line or along side of a through connection, and thus avoid the disturbing effects of two widely separated grounds. The control of the new switching devices is, in the case of the trunk, associated with the hook switch of the called subscriber through the agency of his supervisory relay, while in the case of connecting cords differentiation between subscribers' and trunk lines is made by the removal of the ground connection from the jack sleeves of the latter class of line.

PARTY LINE SWITCHING APPARATUS.

Two switching devices for party lines are the respective subjects of patents, one of these latter being issued to C. H. Prött, of Germany, and the other to Messrs. T. W. Gleason and R. Hamilton, of Boston, Mass.

The system of the former gives the primary control of the line to a main station, which is to receive the central office signals and transmit them to the desired station through a manual switching commutator. As soon as a connection is completed, an electromagnetic lock at each station prevents interference from those stations not involved in it. Each sub-station has a manually-operated

commutator for calling the central office or selecting any of the other line stations, the same lock-out conditions existing as for an incoming call.

The second system employs electrically-operated automatic switches working on the step-by-step principle. These are controlled for all stations from any one, by circuit-making and breaking devices, which, through resulting current impulses on the line, rotate selective commutators at each station. Complete lock-out and automatic return of the selective commutators is provided, all the functions being carried out over two line wires, which also serve as the talking circuit.

Recent Electrochemical Developments.

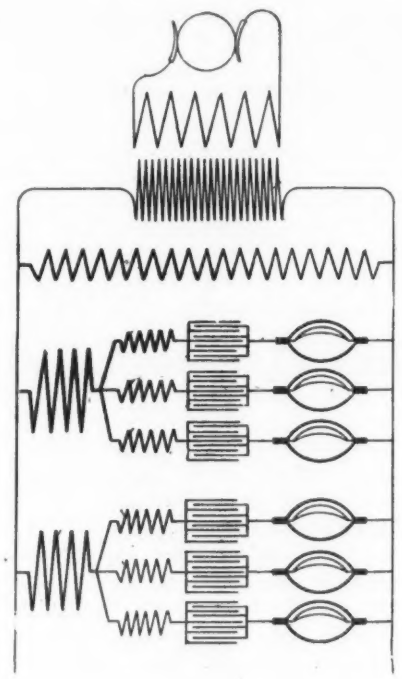
ELECTRIC MANUFACTURE OF IRON ALLOYS.

For the electric furnace production of iron alloys, such as ferro-silicon or ferro-manganese, with the simultaneous production of alkaline oxides or alkaline earths, a patent was granted on March 8 to G. Gin, of Paris, France, who has in recent years been an active worker in the application of electrical methods to the metallurgy of iron and steel. His new process may be best explained by its application to the production of ferro-silicon and baryta.

The process consists of two steps. In the first step, which does not necessarily require an electric furnace, since a high temperature is not required, he subjects a mixture of broken quartz or non-clayey sand, barium sulphate and charcoal to a heating action to produce barium silicate. The barium silicate is then mixed with an oxide of iron or metallic iron and carbon and treated in a second operation in an electric furnace to produce ferro-silicon and barium oxide. The latter is collected in the form of a sublimate.

FIXATION OF NITROGEN FROM THE AIR.

In view of the enormous commercial consequences which a successful economical solution of the problem of the fixation of nitrogen from air would have especially in agricultural chemistry, the work undertaken by Bradley and Lovejoy at Niagara Falls has aroused great interest all over the world. Naturally other workers have entered the field. A patent granted to J. von Kowalski and I. Moscicki, of Freiburg, Switzerland, relates to the same problem. Their apparatus is shown in Fig. 1. The secondary of a transformer supplies



KOWALSKI AND MOSCICKI METHOD OF PRODUCING NITROGEN, ETC.

alternating current to mains across which are connected in parallel a main induction coil and a number of groups of induction coils, condensers and air-gaps, in a manner clearly seen from the illustration. Across the air-gap a series of sparks in the nature of an arc is produced, and the desired nitrogen compounds are obtained from the air.

The inventors give the following data taken from a plant for the production of nitric acid: The secondary circuit had an e.m.f. of 50,000 volts, producing spark arcs of about 24 cm. length in each gap. In each consumption branch the current was 0.05 amp. and the frequency about 6,000 cycles per second, while the frequency of the alternating current in the secondary circuit outside the consumption branches was 50 cycles per second. The apparatus required 33 hp, and with these were obtained 1,155 grams of nitric acid per hour from atmospheric air; that is, 35 grams of nitric acid per hp-hour. It was found that the frequency of the current in the consumption branch should have a minimum of 6,000 cycles per second and a maximum of 10,000 cycles per second.

To produce a frequency between these limits the induction coils and condensers shown in the illustration must be properly proportioned. By applying several condensers in parallel the inventors intend to get a sufficiently high frequency, while the inductance coil in series with each condenser prevents the frequency from overstepping the maximum limit. The inductance coil in series with each group of inductance coils and condensers is intended to maintain the original frequency of the alternating current in all parts of the secondary circuit outside the consumption branches, by preventing the propagation of the oscillatory currents by the condenser beyond its respective consumption branch. The main induction coil which is connected across the mains and which is in parallel with all the different groups of consumption branches is intended to eliminate the production of a wattless component in the secondary circuit in order to maintain a high efficiency.

The predetermination of the different inductance coils and condensers suggests the solution of a problem which is not electrochemical, but distinctly in the realm of alternating-current engineering. The ordinary methods of treating alternating-current phenomena, like Steinmetz's symbolic method, are, of course, not applicable to this case, because the fundamental supposition of their application is that there is a constant frequency all over the circuit. What the inventors disclose in their patent is a method of producing and maintaining a frequency between certain limits. There are, of course, analytical methods by which this problem can be treated with the aid of calculus, but a method of the same simplicity and beauty as Steinmetz's method for dealing with the phenomena in a circuit of constant frequency, has not yet been devised for describing the transformation of frequencies.

MISCELLANEOUS.

The porosity of carbon electrodes is one of the reasons which cause their quick disintegration. There is also experienced a creeping of the solution upwards with a resulting corrosion of the metallic connections. The latter disadvantage has even been experienced with artificial graphite electrodes which are otherwise much superior to, and much more porous than, ordinary carbon, and to overcome this disadvantage, the electrodes have often been impregnated with paraffin with good success. A patent granted to G. J. Atkins, of Tottenham, England, refers to a similar method, the special feature of which seems to be the use of an oxidisable oil, such as linseed oil or cottonseed oil. The disadvantages claimed are that the oil is gradually oxidized and forms an insoluble material which is not attacked by the electrolyte and does not melt when the electrode becomes warm.

The production of ozone from air—for the purpose of using the ozone afterwards for the sterilization of water—depends upon the production of silent discharges and the prevention of arcs. For this purpose solid dielectrics like glass are often resorted to, as for instance in the ozonizer of Siemens & Halske. The objectionable feature of this is that the glass may break, so that no ozone is formed and the water is not sterilized. In order to get along without solid dielectrics A. Vosmaer and A. Lebret, of Amsterdam, Holland, have studied the conditions under which silent discharges without arcs are produced in an air-gap. From a paper of van't Hoff of last year it appears that their system has been in successful use for some time in Holland. In a patent granted to them on March 8, they state that silent discharges depend upon a high voltage and a low current, and are best produced by connecting the air-gap in shunt with a condenser to the terminals of the secondary of a transformer, an induction coil being inserted between the secondary of the transformers and the condenser.

A patent granted to A. Müller, of New York City, refers to mechanical details of a battery stopper, for preventing the spilling of the battery liquid.

Fessenden Wireless Telegraph Patents.

Three new patents were issued March 8 to Prof. R. A. Fessenden. Of these one[1] is a subdivision of No. 753,863 and relates to wireless signalling as described in a previous article. The second patent[2] embodies specifically a radiator or resonator system as shown in Fig. 1, made in the form of a cone and having a large capacity. The cone may be made of sheet metal or formed of a network of wires. This horizontal metal cone serves to deflect the radiated waves and direct them along the surface of the earth. A horizontal conductor, the length of which is equal to the base of the cone, extends in the direction the waves are to be propagated and may include an inductance, as shown.

The third patent[3] relates to a method of transforming alternating currents into high-frequency oscillations by operating a generator with a steam turbine. The inventor points out in this particular specification that where a reciprocating steam engine is used to

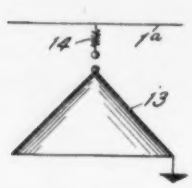


FIG. 1.—RADIATOR.

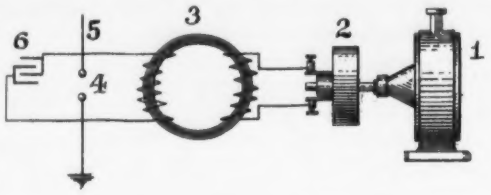


FIG. 2.—ALTERNATING-CURRENT GENERATOR CONNECTED TO STEAM TURBINE.

actuate a generator it is not possible to obtain a high peripheral speed of the moving coils of wire; that is to say, 3,000 or 4,000 r.p.m. are not nearly great enough and to obtain speeds of 25,000 or 30,000 r.p.m. a steam turbine must be employed.

By referring to Fig. 2 the steam turbine is represented connected to a revolving-pole alternating generator operating a transformer. The increased potential from the secondary charges the condensers, which finally disrupt an air-gap and so sets up oscillations in the radiator system, 5; thus a high peripheral velocity with small circumference of moving parts may be obtained.

The advantages of this improvement are illustrated by numerical statements. It is claimed that a fundamental and radically new effect is obtained by employing a prime-mover having a constant torque to operate a generator armature of small diameter, as for example, two feet—and a high peripheral speed—as for example, ten miles per minute. If the pole pieces have a width of one-twentieth of an inch a periodicity of 100,000 per second may be obtained. With a reciprocating engine giving 600,000 r.p.m. the diameter of the armature would have to be 260 ft. to give the same number of periods per second with the same width of pole pieces.

Many advantages of this new combination are pointed out by its designer, among the more important being that the torque is exceedingly uniform; a high peripheral velocity reduces the number of poles and hence eliminates largely disturbance from resonance; there will be a smaller change in periodicity when signals are sent and the generator will not be thrown out of resonance; a light and portable wireless telegraph set may be constructed and such a set will not give rise to vibrations to disturb the operation of the station.

Meeting of the Iowa Telephone Association.

The eighth annual meeting of the Iowa Telephone Association was called to order Tuesday afternoon, March 8, at Des Moines, by the vice-president, Mr. J. C. Sullivan. The meeting was adjourned until Tuesday evening. After the appointment of the committee on credentials at that session, the annual address of the president was given, his topic being "Combinations and their Necessity in the Telephone Business in Iowa." The subject of "Long-Distance Lines" was handled by P. C. Holdeogel, of Rockwell City.

At the session Wednesday morning "Farm Lines" were discussed in many details and phases. The subject seemed to be an interesting one to most of those present, as it evoked a great deal of discussion.

[1] No. 753,863. Wireless Signalling. U. S. Letters Patent.
[2] No. 753,864. Signalling by Electromagnetic Waves. U. S. Patent.
[3] No. 754,058. Signalling by Electromagnetic Waves. U. S. Patent.

Papers presented at this session were: "Jealousy Among Independent Telephone Men," by H. E. Ralston, of Maitland, Mo.; "Operating a Telephone Plant as a Side Line," J. C. Thorne; "Our Business Relations," Paul H. Patton, of Waterloo, and "Our Loyalty to the Principles of the Association," by H. A. Kinney, of Woodbine.

A special session was called for Wednesday afternoon to discuss the papers of D. M. Griswold, of Des Moines, on "Necessity of Uniformity in Toll Line Service and Rates," and by J. M. Plaister, of Ft. Dodge, "Shall We Establish a Clearing House?" The discussion brought out the fact long realized by many that there is urgent need for a clearing house or similar office, but the meeting was somewhat divided as to the scope of a plan and the details to be arranged.

On Wednesday evening about 200 of the members of the Association and their friends sat down to a dinner served at Our Circle Hall. Following the banquet, Mr. U. S. Alderman, acting as toastmaster, called on Governor A. B. Cummins for an address which was largely in the nature of a welcome. The Hon. Lafayette Young spoke on the subject, "A Long-Distance Hot Wire." Mr. Young was in a very happy vein, and thoroughly entertained his hearers. Mr. A. L. Urick, of the State Federation of Labor, spoke on the "Relation of Employer and Employee," and was listened to with great interest. Judge Nichols responded to the toast, "Service," with a very fine address.

At the last session which was held Thursday morning, E. H. Martin, of Webster City, had for his topic, "How Can We Promote Better Feeling Among Toll Operators, Inducing Harmony, Improving Our Service, and thus Reducing the Lost Call Record?" The following were elected officers for the ensuing year: J. C. Sullivan, of Creston, president; S. S. Lichty, of Vinton, vice-president; Charles C. Deering, of Des Moines, secretary and treasurer. Executive Committee—J. S. Bellamy, of Knoxville; J. C. Thorne, of Fairfield; P. C. Holdeogel, of Rockwell City, and W. S. Alderman, of Nevada.

Among those present, on behalf of supply concerns, and representing local telephone companies were: H. McCartney, J. C. Sullivan, Geo. E. Atkinson, Charles C. Deering, George N. Bandy, J. S. Bellamy, R. S. Redman, S. S. Lichty, J. C. Thorne, Paul H. Patton, J. M. Plaister, G. F. Bygel, M. I. Berger, G. O. Lundgren, S. A. Dinsmore, F. L. McGillen, W. B. Swaney, E. H. Martin, W. E. Doolittle, J. E. Keelyn, E. B. Overshiner, F. C. Musson, W. R. Hind, W. H. Trimm, A. J. Carter, Wm. Bowen, Fred Walthauer, H. A. Jones, W. S. Arnold, F. M. Boardman, N. G. Harvey, M. McNeill, P. J. Eubanks, H. P. Blackledge, W. R. Hauptman, W. O. Bryan, H. S. Durant, E. J. Pietzcher, W. J. Crawford, B. J. Carney, A. L. Plummer, C. C. Keister, A. T. Whittle, P. C. Holdoegel, J. H. Bradt, Claus Anderson, Francis Anderson, O. C. Cochran, O. A. Repass, H. A. Kinney, H. L. Bell, H. E. Ralston, F. H. Jones, J. W. Brown, H. U. Anderson, L. L. Bowlin, Senator Brooks, G. W. Greaves, J. A. Brown, Charles R. Kirk, Mr. Shipley, Mr. Brooksmith, H. H. Herr, F. E. Dupee, W. O. Wells, F. W. Lindquist, S. E. Weitzel, W. D. Dunsmore.

Telegraphy and Telephony in Germany.

According to the statistics of the German Federal Post Office and Telegraph Department for 1902 all branches show an increase, though the number of telegrams is somewhat reduced, the result of the extension of the telephone system. The number of federal telegraph offices was 22,292, against 21,150 in 1901; that of telephone offices, 16,292, against 15,200.

The total personnel of the federal post-office and telegraph service at the end of 1902 was 209,906 persons, being an increase of 7,319 persons, or 3.6 per cent. over 1901. Among this number were 85,267 full officials (82,861 in 1901), inclusive of 9,562 (8,963 in 1901) females. The number of post and telegraph offices owned by the Federal Government increased from 476 in 1901 to 490 in 1902. The number of telegrams was 41,118,729, against 41,125,033 in 1901, being a decrease of 6,304.

The telephone conversations, however, increased from 692,687,730 in 1901 to 757,648,580 in 1902, an increase of 75,000,000 per year, or over 200,000 per day.

Single Phase Traction Meeting in Chicago.

The Chicago branch meetings of the A. I. E. E. of this year, in every case, have exceeded the seating capacity of the Western Society of Engineers' meeting room, which seats about 100. The meeting for the discussion of single-phase traction systems was, everything considered, the most successful meeting of the Institute ever held in Chicago, quantity and quality of attendance both being considered.

President Arnold presided at the meeting, and in response to a number of references by various speakers to the part he had taken in the pioneer work of bringing about a realization of the necessity for some single-phase alternating-current traction system, expressed his appreciation, and said that it was always a pleasure to see one's prophecies come true.

The discussion of the subject was opened by Mr. Clarence Renshaw, who took up the theory of both the single-phase series motor and the repulsion motor. In analyzing this question he said that the single-phase repulsion motor, while it did away with the necessity for a step-down transformer on the car (since the fields of the motor could be operated at a high voltage) the increased weight of the repulsion motor, with its high-voltage field windings, was enough more on a four-repulsion motor equipment than on a four-motor equipment of series single-phase motors to counteract any saving in weight due to the absence of a transformer on the car equipped with the repulsion motor.

The operation of a series single-phase motor on direct-current trolley lines, while quite possible, was not recommended by him as good engineering except where it was absolutely necessary. In most cases where an interurban car comes over city lines, he thought that the running of a second trolley wire was advisable, so that the interurban cars could operate with alternating current. If the series single-phase motor car was to be run from direct current it must be equipped with rheostatic control, and this wiped out all of the economies possible by the use of induction control for accelerating and slow-speed running.

Mr. W. A. Blanck presented a paper giving the comparative cost of a sixty-mile interurban railway electrical equipment with direct current supplied from sub-stations and with single-phase alternating current. Mr. Blanck's figures showed a difference of about $2,000 a mile in favor of the single-phase alternating-current system.

CURRENT NEWS AND NOTES.

CONTRABAND.—The Russian war regulations declares telegraph and telephone material as being on the contraband list.

THE METRIC SYSTEM IN GREAT BRITAIN.—The House of Lords has unanimously passed a bill making compulsory the metric system in Great Britain on April 5, 1906, or at such later date as may be directed by an Order in Council.

MONORAIL IN ENGLAND.—During the past week a model of the Behr monorail system, proposed for installation between Liverpool and Manchester, has been shown in London. It seems high time something was done to build that line, of which we have now heard so much.

WRECK OF CABLE STEAMER SCOTIA.—The good old *Scotia*, a cable steamer known to a great many of our readers, is, it is feared, a total wreck in the Pacific. A special dispatch from Washington, D. C., of March 12 says: "Wrecked within a short distance of a safe harbor, the crew of the cable ship *Scotia* was rescued by the naval garrison at Guam. The supplies carried by the ship, which were intended for the Commercial Pacific cable station at Guam, have been partly saved, but the ship is apparently a total loss. Lieutenant Raymond Stone, Acting Governor of Guam, sent a cablegram, dated yesterday, to the Navy Department, in which he said: 'Cable ship *Scotia* has been wrecked on Callahan Bank, coming in, March 11, northeast and north Spanish rock five hundred feet approximately. Leading marks intact; entrance buoy is partly sunk. Vessel is lying in dangerous position, but cargo can be recovered if wrecking vessels arrive while weather continues favorable. I am rendering assistance with all resources available. I am feeding and sheltering part of the crew on shore. *Scotia* suffered from want of provisions. Ship probably totally ruined. No wrecked people lost.'"

INSTITUTE NEW YORK MEETING.—The 185th meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth Street, New York, Friday, March 25, at 8.15 P.M. The following papers will be presented for discussion: 1. "The Relative Fire Risk of Oil and Air-Blast Transformers," by E. W. Rice, Jr., technical director of the General Electric Company, Schenectady, N. Y. 2. "Use of Group Switches in Large Power Plants," by L. B. Stillwell, electrical director of the Interborough Rapid Transit Railway Company. 3. "Oil Switches for High Pressures," by E. M. Hewlett, engineer of the General Electric Company, Schenectady, N. Y. 4. "Terminals and Bushings for High-Pressure Transformers," by Walter S. Moody, electrical engineer with General Electric Company, Schenectady, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Mr. Charles L. Edgar, president of the National Electric Light Association, was in New York several days this week looking after Association affairs. President Edgar was accompanied by Past-President James I. Ayer, whom he has been fortunate enough to induce to act as chairman of the entertainment committee of the twenty-seventh convention, to be held in Boston May 24-27. The entertainment committee, among its other duties, will have charge of assigning rooms at the Vendome, which is to be the headquarters of the Association, and particulars regarding rates, etc., will be issued very soon. As delegates sometimes prefer to stop at a smaller or quieter hotel than that selected for convention headquarters, arrangements will be made by which they also can secure through the committee such accommodations as they prefer. In fact, hotel arrangements promise to be more systematic and satisfactory than on previous occasions.

RAYING OUT WAR SCARS.—A special dispatch from London says: "London has a new scientific surgical sensation in the application of the Finsen rays—which are apparently allied to the Röntgen—for the removal of scars following wounds, whether inflicted in war or by the surgeon's knife. Lately quite a number of British subalterns have sought out the "light-curer" for the removal of face wounds received in South Africa. The custom is rapidly growing of surgeons sending their patients to have the scars left by operations removed. A "light-curer" gives the following description of the process: "Repeated applications of the Finsen light in a powerful form are given until the blood corpuscles are stimulated to such an extent that, by distension of the cells and other resultant processes, new tissue is formed and scars disappear."

STAFF FOR SIGNAL SERVICE.—The United States Civil Service Commission announces an examination April 6-7, 1904, to secure eligibles from which to make certification to fill vacancies in the position of assistant electrical engineer in the Signal Service at Large, Washington, D. C., at $1,400 per annum, and other similar vacancies as they may occur. The examination will consist of the subjects mentioned below, which will be weighted as follows: 1. Theoretical and practical questions in electrical engineering, 75. 2. Technical training and experience (rated on application), 25; total, 100. Two days will be required for this examination. Age limit, 20 years or over. Applicants for this position should have a good general knowledge of electrical science, and should be thoroughly familiar with telephone, telegraph and cable engineering. This examination is open to all citizens of the United States who comply with the requirements. Competitors will be rated without regard to any consideration other than the qualifications shown in their examination papers, and eligibles will be certified strictly in accordance with the civil service law and rules. Persons who desire to compete should at once apply either to the United States Civil Service Commission, Washington, D. C., for application Form 1312, which should be properly executed and filed with the Commission at Washington. Persons who are unable to file their formal applications and who notify the Commission of this fact, either by letter or telegram, with the request that they be permitted to take the examination, will be examined, subject to the subsequent filing of their applications, provided their requests are received at the Commission in sufficient time to ship examination papers.

LETTERS TO THE EDITORS.

The Theory of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—I beg to thank you for having given space to my communication of January 2 and for the favorable comment in your editorial of January 16. I am entirely in accord with the views which you express in this editorial and I find of much interest the hypothesis in which you complete my modest contribution—necessarily very incomplete—by the consideration of a conducting atmospheric stratum forming a second and parallel surface at a height of about 50 miles. One may have doubts, it is true, on the manner in which such a stratum conducts, since it would probably follow laws of conduction different from those applying to metals; but the hypothesis is none the less interesting and it could be verified up to a certain point by a study of the law of distances. Properly speaking, the theory which I have sought to develop applies for distances much smaller than those at which the upper stratum intervenes, and it may be in error for greater distances. The quantity of energy received by an antenna would then first decrease according to the law of inverse squares of the distance, and next simply inversely with the distance. It is to be understood that I entirely agree with you on the subject of superficial currents, of which the earth is the seat and which establish the electrical junction between the lines of force ending normally at the earth, for each half wave. If we imagine a symmetrical antenna beneath the surface, supposed to be equivalent to a thin layer, superficial currents equal and of opposite signs would be produced in this layer and annul the preceding ones. This justifies us in saying that a system of an antenna and earth is equivalent, from the standpoint of action at a distance, to a system of the antenna and its image.

I have also read with much interest the letters which my communication has brought forth from Prof. Fessenden and Mr. Taylor. It is somewhat amusing to find that they are in complete contradiction with each other, which, however, was easy to predict. My position with respect to them is rendered more simple for the reason that I do not pretend to have made a great invention, but merely to have understood rationally, by the exercise of simple common sense, existing theories; and I do not think there is any need of inventing half waves as Prof. Fessenden has done, nor sliding waves as Mr. Taylor has done, for the simple reason that these waves have long been known from the work of Hertz.

As to the other remarks of Prof. Fessenden, I am entirely disposed to be in complete agreement with him when experiment has enabled me to appreciate the practical value of his new bolometric detector, which, up to the present, I have not had an opportunity to examine closely. In principle the employment of the bolometer would appear to offer an excellent solution to the problem of syntonic reception. I am not sure, however, that the gold coherers tested by Prof. Fessenden were of the same type as my own. I am happy to note that the theoretical ideas of Prof. Fessenden have many points of contact with my own.

With respect to the remarks of Mr. Taylor, I note with pleasure his emphatic affirmation that his theory is different from mine; and since he desires it I am entirely ready to give in detail my objection to the "erroneous ideas" which he reproaches me with having criticised without proper examination.

1. The form of the waves indicated by Mr. Taylor is incompatible with a propagation with the velocity of light, for the crest of the waves of Mr. Taylor are displaced tangentially to the lines of electric force, which is contrary to the principles of the propagation of electromagnetic waves, which are always propagated transversely. At all points of electromagnetic waves, according to the theorem of Poynting, the propagation of energy is directed according to a vector perpendicular at the same time to the lines of electric force and to the lines of magnetic force; whereas Mr. Taylor would have an energy vector tangential to the lines of electric force at the crest of the loops of the waves.

2. The distinction which Mr. Taylor makes between waves propagated in free ether and along a wire does not conform to established principles, and the citation which he makes from the work of Hertz cannot justify it. Hertz has, indeed, indicated a form of wave along wires analogous to that which Mr. Taylor cites (work of Hertz, German edition, Vol. II, page 167, Fig. 32B); but he was careful to point out that this form applies only to waves having a velocity less than that of light, and should be replaced by the form *C*, corresponding to a transmission purely transversal if the propagation of waves takes place with the velocity of light. Hertz was very much astonished that his experiment on propagation along conductors had given him only results contrary to the theory of Maxwell, and expressed the greatest doubt on the subject of the correctness of the form 32B. Since that epoch, however, numerous experimenters, notably M. Blondlot, in 1891, have shown that the experiments of Hertz were inexact on this point, and that the propagation along wires takes place with the velocity of light, thus contradicting the result found by Hertz. If, then, Mr. Taylor wishes to apply the theory of Hertz, it is necessary to adopt the form 32C and not the inexact 32C which he has chosen.

3. There is no identity between the case of propagation along a wire and the case of propagation along a plane surface. A wire necessarily produces a *concentration*, for it is surrounded with lines of electric force perpendicular to its surface and radiating all around it; and nothing similar is produced in the case of a plane surface. Besides, all the experiments with propagation along wires are made in reality with two conductors; or rather, two parallel wires are employed between which the field is concentrated, or a wire is stretched horizontally above the earth, in which case the earth itself serves as a second conductor, and the field is concentrated between the wire and the earth. Nothing resembling this occurs in the case of a vertical wire. One can easily conceive that in the case of two parallel conductors the energy remains concentrated between them and there is no loss from radiation since there passes simultaneously through the two wires current of opposite sign. On the contrary, in the case of a plane surface, there is nothing to prevent natural propagation and radiation. If the antenna produces effects at great distances it is precisely because it is alone and no parallel conductor intervenes to reduce its radiation. If one used two vertical antennæ, one alongside of and parallel to the other, and connected with opposite electrodes, according to the arrangement ordinarily employed in the study of propagation along wires (methods of Lecher, Blondlot, etc.), no effect occurs at a distance.

4. My theory does not prevent in any manner the admission that waves are guided by conductors, since on the contrary we know that they are guided at their lower portion by the ground. It may be that the curve of distribution to which calculation leads does not correspond exactly with reality, and that the energy remains more concentrated at the surface of the soil; experiments alone can establish this, but even if it is shown, this will not contradict the fact that the propagation is transversal by polarized hemispherical waves, as I have pointed out. It would simply prove that the distribution of the energy in these waves differs somewhat from that which the elementary theory developed indicates; or rather, that the energy is absorbed more quickly by the gaseous medii of the atmosphere, than in the immediate neighborhood of the soil. Moreover, there is no incompatibility between this general propagation by hemispherical waves and local deformation of waves produced by irregularities of the ground. The phenomena of diffraction are in no respect denied by the general conception of spherical waves.

5. As to the form of the lines of force, which seems so extraordinary to Mr. Taylor, it is much less so to my mind than that of lines of force studied by Hertz. (*Loco citato*, pages 156-157). If Mr. Taylor will read the explanations of Hertz, he will see how much more complicated in reality is the movement of these waves than I have assumed; he will also see that the waves of Hertz attain the same final form as that which I have indicated.

6. As concerns the velocity of propagation of waves, Mr. Taylor reproaches me with supposing that the velocity of light is only attained after a certain number of wave lengths from the source, which he says is in conflict with known laws, provided *disturbing factors in the way of reflections, interferences*, etc., are absent. To this my reply is that there *is* a phenomenon of wave reflection at the summit of the antenna, and that I have specified nothing concerning the number of wave lengths after which the velocity of propagation becomes equal to that of light. Moreover, this distance matters little so far as concerns the results; that is to say, as to the final hemispherical form taken by the waves and the general manner in which they become deformed after leaving the origin. I shall

be happy if these explanations serve to convince Mr. Taylor, or if they should be found of interest by your readers.

PARIS, FRANCE. A. BLONDEL.

Sale of Power by Municipal Plants.

To the Editors of Electrical World and Engineer

SIRS:—An article in the ELECTRICAL WORLD AND ENGINEER of February 20 on the new installation at the City of South Norwalk Electric Works, by A. E. Winchester, came to my notice recently and I wish to call attention to an erroneous statement with reference to rates. He says: "For a continuous consumption of say 50 hp, measured by the customers' meters, the rate would be 1.9 cent per horse-power-hour, corresponding to $4.95 per month of 26 10-hour days. There is no place known where power can be obtained so cheaply."

I take exception to the assertion that "there is no place where power can be obtained so cheaply," and think before the municipal central station superintendent makes an erroneous statement and attempts to mislead others by presuming that a municipal plant is the only one from which cheap power can be obtained, that he should make some effort to inform himself of rates in vogue in other cities and towns. The assertion may sound well in his own city, but to those of us who know better it is absurd. However, it is in the same strain of the rest of the misleading statements that emanate from the mouths of the municipal central station promotors or advocates.

The writer knows of cities and towns in his own neighborhood that sell current for less than 1.9 cents per horse-power-hour, and give 24 hours' service and furnish free lamp renewals. As one who is opposed to the confiscation of property, I believe with you that every misleading statement emanating from the agitators of municipal ownership, should be called to account.

ONEIDA, N. Y. C. W. KOINER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Progress in Dynamo Design.—LOEWY.—The first part of an illustrated summary of the progress made in dynamo design in the year 1903. The author first discusses new designs of direct-current machines. Generators with compensated armature field and with devices for preventing sparking are of special interest. He describes at some length the compensated machine of Ziehl. The field magnet is designed and wound like the stator of a three-phase machine. The winding of phase *I* in Fig. 1 is in shunt to the armature when the machine is a dynamo, and across the supply mains when the machine runs as motor. It serves for generating the exciting field, *Me*. The other two phases of which one, for instance, *II*, is wound in a direction directly opposite to that ordinarily used in three-phase machines, are supplied with the armature current and serve for producing the field, *Mg*, which is of the same size, but of opposite direction, as the armature field, *Ma*, so that the latter is compensated. In Fig. 2 the drawing at the top shows the three windings, the next one gives in dark lines the field, *Mg*, which results from composition of the fields *II* and *III*. The drawing at the bottom shows the field, *Mg*, as it really is in practice, as well as the exciting field, *Me*, and the armature field, *Ma*, which is completely compensated for by the field, *Mg*. In using this method for the connections between an alternator and its exciter, the armature reaction is annihilated and the generator gives the same voltage at any load. Instead of giving the same ampere winding to *II* and *III*, it is possible to increase the ampere winding of one and diminish those of the other by the same amount, which may be accomplished by means of a regulating resistance connected in parallel to one phase. If the ampere windings of *III* are increased, the exciting field, *Me*, is strengthened, while by increasing the ampere windings of *II*, the exciting field, *Me*, is weakened. It is thus possible without regulating the current in winding *I*, which produces the exciting field, *Me*, to change the value of this field and thus to change the voltage of direct or alternating current or polyphase machines when loaded or to change the number of revolutions of direct-current motors and to change the phase difference of synchronous motors or three-phase to direct-current converters. In order to use more stator windings for the generation of the exciting field, it is possible to make use of two of the three windings for this purpose and to generate the opposing field with the third one only.—*Zeit. f. Elek.*, February 21.

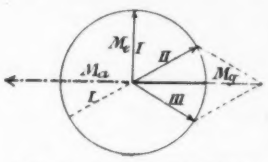


FIG. 1.—PHASE DIAGRAM.

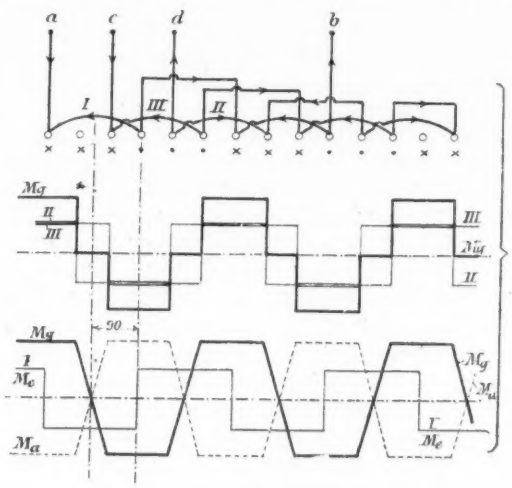


FIG. 2.—DIAGRAM OF WINDINGS DEVELOPED.

Direct-Current Machines.—SCHULZ.—An article on the progress made on the design of direct-current dynamos. While formerly the appearance of sparks at the commutator was often considered to represent the limit of load, the limit is now mostly found in the heating since it is possible to assure good commutation quite successfully. There is now a tendency to provide good ventilation in order to also counteract the heating. The author gives several formulas which have been proposed for the choice of the armature dimensions. Concerning the number of poles he says that more-pole machines are always preferable to machines with few poles and the latter should only be chosen if the calculated air-gap with the more pole arrangement would lead to mechanical difficulties. The price of the magnet yoke, the magnet coil copper and the armature copper is lower with a four-pole machine than with a two-pole machine, while the magnet cores and pole shoes are more expensive for the four-pole machine; but in the latter case the difference is insignificant. He then discusses the various formulas given for determining the commutation from the reactance voltage, but says that the reactance voltage alone should not be considered the only point upon which good commutation depends. There is also distortion of the field, and even with a good reactance voltage it may cause an impermissible brush displacement on account of field distortion. The use of sheet iron for the magnets or at least for the pole shoes has largely increased. This is probably due mainly to a better understanding of the importance of a correct pole shoe shape. The cost of manufacture is not very different, since sheet iron is cheaper than cast steel. The author concludes with some remarks on standardization.—*Elek. Anz.*, February 14.

REFERENCES.

Speed Regulation of Induction Motors with Commutator.—LATOUR.—While it is known that the use of a commutator with alternating-current machines enables one to operate them without phase difference at normal load with perfect commutation, and to start single-phase motors with a good torque, the author endeavors to show mathematically that it also enables one to change the speed of induction motors without influencing the efficiency. The author gives

the theory for shunt and series polyphase motors and makes some brief remarks on single-phase motors.—*L'Eclairage Elec.*, February 27.

Single-Phase Commutator Motors.—BLONDEL.—In a continuation of his very long serial on the theory of single-phase commutator motors, the author begins to discuss analytically and with the aid of diagrams the theory of the repulsion motor with supplementary shunt excitation.—*L'Eclairage Elec.*, February 27.

Single-Phase Commutator Motors.—EICHBERG.—The first part of a complete illustrated translation of the long paper of Eichberg read before the Berlin Electrical Society and abstracted recently in the Digest.—Lond. *Elec. Eng.*, February 26.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—BODENSTEIN.—A brief account of experiments with a mercury vapor lamp made of fused quartz (of Heræus). The lamp is built in form of an H and the arc plays through the nearly horizontal tube between the mercury surfaces in the two vertical arms. For connections iridium wires are used. A small tube at the side of, and communicating with, one vertical tube of the H lamp is filled with mercury and is electrically heated. The mercury evaporates and the vapor presses the liquid mercury through the nearly horizontal tube so far that it makes a short circuit with the mercury in the other vertical tube. An automatic device then disconnects the heating current. The mercury vapor in the side tube condenses again and sucks the liquid mercury back and the arc is lighted through the nearly horizontal tube. Concerning the energy consumption it is said that by a rough estimation the lamp gives for 2 amperes at 100 volts the same illumination as an arc between carbon switch 20 amperes and 50 volts, but is much more constant. In spite of its green color, the light is rich in ultra-violet rays and for this reason suitable for many special scientific investigations. At the beginning of the use of the lamp a strong smell of ozone was observed.—*Zeit. f. Elektrochemie*, February 19.

POWER.

Austrian Transmission Plant.—BOEMENDAL.—A detailed and profusely-illustrated description of the water power plant using rapids of the River Mur. There are four turbine-driven, 500-kw generators with a power factor of 0.85. The generating voltage is 1,500. For transmission the current is transformed up to 21,000 volts by means of three 650-kw sets of transformers. Single-phase transformers are used in order to secure the advantage of the delta connection, so that should one transformer get out of order the other two could keep up the supply, working in V form under an overload for which they are designed. Most careful attention has been given to the arrangement of the ovehead conductors. These consist of three copper wires, 38.7 sq. mm. (0.06 sq. in.), carried on porcelain insulators. The latter have a triple bell; they are fixed on their wood supports with the interposition of porcelain studs screwed in hardwood, fully impregnated with paraffin. The testing of the insulators has been carried out with great care, using a 120,000-volt pressure, the tests having been made, as far as practicable, by placing the insulators in service conditions and under a water spray. The three wires are mounted in a 3-ft. 3⅜-in. equilateral triangle. One insulator is at the top of the post, and the two others are on wood brackets. Every post is fitted with a lightning rod suitably connected to earth, and at about every 1,000 yards there are provided lightning arresters with magnetic blow-out devices. An incident is recorded which occurred when the line first started working. The first section of the line was first set alive as far as the nearest switch and the tension was gradually raised up to 24,000 volts, the section remaining under these conditions for thirty minutes. This was effected in the case of four consecutive sections with satisfactory results. When, however, the fifth section was connected up, and the pressure had risen to over 18,000 volts, a short-circuit was produced and the 21,000-volt fuse blew. As a matter of fact, this section bore the 18,000-volt pressure for an indefinite time; but on its being gradually raised by only 50 volts the short-circuit occurred. The cause of this, after rather lengthy investigations, was found to be the cracking of an insulator, producing thereby the short-circuit, although the crack did not go through the whole thickness of the porcelain. The experiments were further carried on, and a series of critical limits of pressure were tabulated; at these limits the very smallest defects in the porcelain insulators are of importance, and may lead to injurious results. The long-distance line has a length of 20 miles, and is divided into eight sections, in order to more easily detect any defects and to cut out any section without stopping the whole plant.—Lond. *Eng'ing*, February 26.

Electric Power in Workshops.—IRWIN.—A paper in abstract read before the Rugby Engineering Society, in which he describes the power supply of the Niclausse boiler works of Willans and Robinson. When these works were being planned, the question of the adoption of direct or alternating current came up. In some respects the alternating current could claim superiority for works of this kind. Since the load was principally made up of motors driving tools and machines at constant speed, induction motors would have been suitable. Other considerations, however, among them that of cost, decided in favor of the direct-current supply. The main supply is at 410 volts from three shunt-wound generators, two of which are 220-kw machines and one a 90-kw machine. Working in parallel with the generators and in conjunction with an automatic booster is a battery of 197 cells. The cells are able to give a discharge of 125 amp. for three hours. Instead of the ordinary three-wire system, with equal voltage on each side of the middle wire, a "balancer" is provided which has two windings and two commutators on the same armature core, and gives 308 volts on one side and about 102 volts on the other. As there is very little load on the 300-volt circuit, the function of the machine is not to balance so much as to give a supply at 100 volts, and it is referred to as a rotary transformer. The reason for this division is, in the first place, to supply 100-volt current for arc welding; secondly, to allow of single arc lamps being run where two lamps would not be necessary; thirdly, to allow, where required, of a large range of speed. Thus, by keeping the field of the motor across the 400-volt circuit and by putting the armature successfully across the 100, 300 and 400-volt circuit, the speed will vary in the ratio of one to three to four. Intermediate speeds can be obtained by field regulation if necessary. The main arc lighting is carried out from the 400-volt circuit, partly by enclosed and partly by open-type lamps. The enclosed lamps are run four in series, and the open-type lamps eight in series. All these lamps are provided with external automatic cut-outs and substitutional resistances. One of the problems to be solved was that of driving the rolling mill and the tube draw benches by means of a motor, without disturbing the arc lamps running off the same set of mains. The motor has a capacity of 275 hp and is compound-wound and drives, by means of ropes, an eight-inch diameter shaft to which the mill and draw benches are coupled. The rope pulley on the shaft is about 15 tons in weight and, therefore, acts as a fly-wheel governor.—Lond. *Elec.*, February 19.

Gas Engines in a Metallurgical Plant.—LANGTON.—An illustrated description of the power plant of the Montezuma Copper Company at Nacozari, Sonoro, Mexico. The power house contains eight gas engines each being connected to a 65-kw direct-current generator. The generators are run in parallel and the current is distributed at 250 volts to some 40 different motors, scattered about the works and ranging in size from 5 to 175 hp. Arc and incandescent lamps are operated from the same circuits as the motors. Producer gas is used and the methods of making the gas either from coal or wood (the latter being the most novel feature of the plant) are described in detail, and the analysis of the gas produced is given. The paper is concluded by some remarks on the use of gas engines in general, and it is pointed out that the most economical capacity of a gas engine is its absolute maximum capacity and in order to allow for variations which are inevitable even under the best conditions of commercial working, the maximum capacity should be discounted about 15 per cent. to get a figure that may be called maximum commercial capacity. This commercial maximum capacity should equal the peak of the load curve. With a very variable load, therefore, an engine capacity is required greatly in excess of the average power demand. This disadvantage counterbalances the advantage of the ease with which gas may be transmitted to scattered gas engines without loss. The author thinks that in most cases the balance of advantage is found to be on the side of a central power house generating electrical energy from gas engines together with electric distribution to motors.—*Electrochem. Ind.*, March.

Electric Haulage in Metal Mines.—CLARK.—A paper in which the author states that the use of electricity for mine haulage has materially cheapened the cost of production; from data compiled at various mines the cost per ton of hauling coal is 50 to 75 per cent. below mule haulage, according to the situation of the mine, the grade of slope

and the distance hauled. The trolley system of haulage has not been extensively used in metal mines. It is particularly adapted to long "tunnel" systems through which is hauled the ore from a number of properties. The conditions of haulage in a metal mine are radically different from those found in coal mines in which a locomotive is required which is very low, but without restriction as to width. The ordinary adit driven to tap metalliferous veins has ample height for any locomotive now on the market, but is usually restricted as to width. Some notes are given on the draw-bar pull required and the influence of grades, and the haulage system of the United Gold Mines Company, of Victor, Colo., is described. It is the only electric mine haulage system in use in the Cripple Creek district. An 8-ton locomotive is used with a draw-bar pull of about 3,500 pounds and a speed of 15 miles per hour. The machine is equipped with a single high-speed motor placed in the center and on the top of the frame, and the motor shaft connects to the drivers by a chain of gearing. The brake is applied directly to the motor shaft. The trolley is hung in the center of the track and has caused no inconvenience. From a water power plant three-phase currents are transmitted a distance of 12 miles at a pressure of 13,000 volts, the frequency being 30 cycles. At the sub-station step-down transformers and rotary converters change the current to 550 volts direct current to the trolley.—*Eng. & Min. Jour.*, February 25.

REFERENCE.

A Swiss Hydroelectric Plant.—COLLISCHONN.—The first part of a profusely-illustrated description of the Kubel water power plant situated at the juncture of the rivers Sitter and Urnaesch. The present installment describes the hydroelectric plant, for which a basin is provided to store enough water so that even in summer time, should new water cease to come, the plant would be able to give for three weeks daily 20,000 hp-hours.—*Elek. Zeit.*, February 25.

TRACTION.

Electric Mountain Road.—HERZOG.—The first part of an illustrated description of the electric railroad from Freiburg to Anet in Switzerland. The length of the road is 32 km. While the third rail is used along the road, the overhead trolley wire is employed in the stations, to prevent accidents. A central station in Freiburg provides 8,000-volt, three-phase currents, which are transmitted to two sub-stations containing motor-generators for producing the 750-volt direct-current supply to the line. The capacity of each sub-station is sufficient to give the energy required by one train. Since the average power required by a train is 150 hp, each sub-station contains a motor-generator of this capacity, together with a storage battery of sufficient capacity to furnish the power required beyond the average.—*L'Eclairage Elec.*, February 27.

Electric Railway in the Isle of Man.—A description of this line which is largely a summer road and has recently been thoroughly reconstructed. A short description is first given of the original plant, which used both water and steam power for generating electricity. The chief work in the reorganization has been in centralizing the power supply. The new generating plant, consisting of 300-kw, 7,000-volt generators, has been installed with three sub-stations containing 150-kw rotaries.—*St. R'y Jour.*, March 5.

REFERENCES.

Alternating-Current Traction.—BELL.—A review of the demand for an alternating-current railway motor. He points out that polyphase motors are not satisfactory, principally because they require two trolley wires, and because they do not have sufficient torque at starting. The writer then discusses the two types of single-phase motors which have been placed on the market, one represented by the Westinghouse and the Finzi motor, the other the repulsion motor as built by the General Electric and other companies.—*St. R'y Jour.*, February 27.

Single-Phase Traction.—EICHBERG.—The first part of a paper read before the Vienna Electrical Society. The author discusses the various types of single-phase motors, giving the characteristic features of the Winter-Eichberg motor, the series motor, the repulsion motor and comparing their relative advantages.—*Zeit. f. Elek.* (Vienna), February 28.

Electric Mine Locomotives.—AFFELDER.—A fully illustrated article on traction, third rail and sprocket locomotives, their development and the conditions to which they are adapted. He thinks that the third-rail haulage system is not a competitor of the traction or trolley system, but rather one to be used when adverse grades make traction haulage impracticable. The third-rail locomotive will continue to become a decided competitor of rope haulage and as such will probably produce its best results.—*Mines and Minerals*, March.

Light Railway.—An illustrated description of the Barking-Becton light railway, which is 1.3 miles in length, the trolley system being used. Owing to the fact that the line carries very few passengers other than workmen employed at the Becton gas works, the load is a very variable one and the system of split shifts has been adopted. In passing over a river it was stipulated that some arrangements would be made whereby it was impossible to open the bridge whenever a car was within a hundred yards on either side. To comply with this requirement, certain interlocking devices were designed which are described. Electric power is used for opening the bridge.—Lond. *Elec.*, February 26.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Voltage Regulation in Alternating-Current Systems.—H. S. MEYER.—A continuation of his illustrated paper, the first part of which was abstracted in the Digest last week. The supply of incandescent lamps demands an almost perfect regulation, since changes—even if only of the order of 2 to 3 per cent.—will have serious consequences for the life and efficiency of the lamps, and, therefore, all ordinary generators, in order to supply satisfactorily a lighting system, need careful attendance at the switchboard. Concerning an induction motor load, he says that under full load and at standard speed the power factor should lie, with a well-designed polyphase induction motor, between 90 and 95 per cent., but when running partially loaded or with slow-speed motors or single-phase machines figures much below those mentioned must be expected, and it may be assumed that motors when used on a supply system will introduce lagging currents amounting to about 60 per cent. of the rated load current of the motor load. By combining separately the wattless and the energy current thus introduced with the corresponding currents of the rest of the load, the resultant power factor is obtained upon which the regulation of the generator depends. A diagram if given to show the influence which a large induction motor starting under heavy load will have on the generator regulation. The author points out that it is wrong and unfair to restrict the starting current of an induction motor to a certain percentage of its full-load current. Such restriction affects a 10-hp motor in the same way as a 1-hp motor, although the disturbances in the voltage regulation in the former case would be ten times as large. Furthermore it gives the advantage to the poorer motor, as this will have a larger full-load current, due to the lower apparent efficiency. The correct way is to either place a limit on the amount of current which may be taken at starting, or, still better, vary the restrictions for each size and grade of motor. The power factor of a synchronous motor can be made leading or lagging at will by varying the strength of the field excitation, so that the synchronous motor offers a simple method of compensating for the effects of inductive loads in other parts of a power system. If a synchronous motor is over-excited so as to take a resultant current 5, 10 or 15 per cent. greater than its normal load current, it is capable of compensating for a lagging current 32, 46 or 57 per cent. as great as its normal load current. The most efficient way of using such machines as "rotary condensers" is by loading the same with 71 per cent. of the rated output mechanically, and then raising the excitation until the resultant current is equal to the rated current. A leading component is then obtained of the same magnitude as the energy component. In spite of such advantages as may be obtained by controlling the power factor, a more general introduction of the synchronous motor for power work is greatly hampered by their inferiority in regard to starting torque. Too many synchronous motors on one system may also lead to trouble, as they are extremely sensitive to any fluctuations in the voltage or impressed frequency as may be caused by the prime-movers.—Lond. *Elec.*, February 26.

Frankfort.—An extract from the annual report of the Frankfort-on-Main municipal lighting and traction plant, which is particularly interesting from the fact that a 5,000-hp steam turbine has been in use since August, 1902. This turbine operates 17 hours a day and is guaranteed for 2,600 kw single-phase current. The main power station also contains four 552-kw turbines and four 1,033-kw turbines. The coal required per kw-hour during the year reported was 1.63 kg. and the cost of coal per kw-hour was 0.75 cent.—*St. R'y Jour.*, February 20.

REFERENCES.

Dangers of Electricity in Mining.—A very long serial with many illustrations. The direct danger of touching a conductor which carries current is enhanced by the particular conditions of mining and has already caused some accidents, on the other hand the more indirect dangers, due to fire and explosion, caused by electric sparks, etc., have caused so far very few accidents, mainly for the reason that in installing an electric plant in a dangerous mine, great and sometimes even exaggerated precautions are taken. The various possibilities of danger are discussed in detail and methods which have been devised for preventing them are described, together with a general account of the arrangements of electric plants in mines. The serial is to be concluded.—*Glückauf,* January 30; February 6, 13, 20, 27.

Electric Installation on Board Ship.—Leblond.—A continuation of his article on electric installations on board warships. In the present installment the author deals especially with the methods used in wiring and the insulation of the conductors.—*L'Ind. Elec.,* February 25.

Ignition of Gas Engines.—Soulier.—An illustrated description of various types of magneto electric machines for producing the sparks for ignition of gas engines, especially in automobiles.—*L'Ind. Elec.,* February 10.

Electro-Physics and Magnetism.

The Structure of the Atom.—J. J. Thomson.—A paper in the first part of which the author discusses a mathematical problem suggested by the view that the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification. The problem discussed by him is the motion of a ring of a given number of negatively electrified particles placed inside a uniformly electrified sphere. The general equations are first developed and are then applied to the cares of two, three, four, five and six corpuscles and the mathematical conditions for the stability of a ring containing more than six corpuscles are developed. The author then applies his mathematical results to the hypothesis that an atom consists of a number of corpuscles moving about in the sphere of uniform electrification, and shows that if the corpuscles are constrained to move in one plane they will arrange themselves in a series of concentric rings, while when they can move about in all directions they will arrange themselves in a series of concentric shells. The author adds the extremely interesting proof that if we assume such a structure of the atom it will have properties analogous in many respects to those possessed by the atoms of the chemical elements and that in particular the properties of the atom will depend upon its atomic weight in a way very analogous to that expressed by the periodic law.—*Phys. Mag.,* March.

Electro-Capillarity.—Christiansen.—An account of experiments in which the author studied some peculiar movements of mercury in

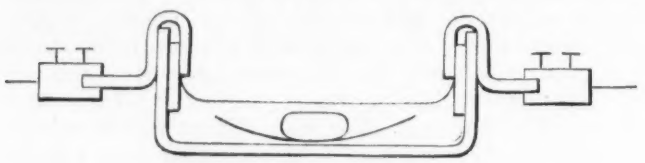


FIG. 3.—ELECTRO-CAPILLARITY.

an electrolyte, due to electro-capillarity. As seen in Fig. 3, a globule of mercury was placed in a watch glass at the bottom of a dish containing a one per cent. solution of potassium nitrate as electrolyte. Platinum electrodes are provided at the two ends of the dish. As long as no current is flowing the mercury globule has a circular shape, as shown in Fig. 4. When the current is then gradually increased the form of the globule varies as shown in Figs. 5 to 9. To

FIGS. 4, 5, 6, 7, 8 AND 9.—ELECTRO-CAPILLARITY.

measure the forces which cause the motion of the mercury, he employed the arrangement shown in Fig. 10, in which a tube is provided at the two ends with two wider tubes to contain the electrolyte. A mercury globule is placed in the middle of the tube. The tendency of the globule to move on account of the flow of the current is counteracted by placing the tube in an inclined position as shown in the figure. A thrd experiment was made with mercury drops, falling through an electrolyte. As long as there is no current the drops fall plumb. but when an electric current is passed through the electrolyte

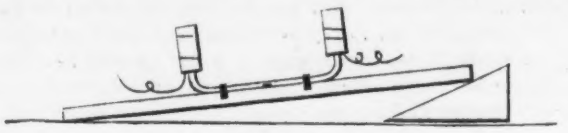


FIG. 10.—ELECTRO-CAPILLARITY.

the drops are deviated from their plumb course towards the negative pole. The deviation is approximately proportional to the current and also depends upon the electrolyte. The author explains these phenomena by the double-layer hypothesis.—Lond. *Elec. Rev.,* February 19.

Photographic Action of Radium Rays.—Skinner.—Since a photographic plate by exposure to radium rays is affected in such a way that the plate develops similarly to its development after its exposure to light, the author has made experiments to find whether the actions are the same in both cases. His results seem to indicate that only slight differences occur in the early stages of development. For prolonged exposure he reaches the following conclusions: The density of the image produced on a plate by exposure to radium rays (β and α) increases to a critical value and then decreases, first rapidly and afterwards very slowly, until a time is reached when the image is totally reversed. Spark images are at first obliterated by radium rays which do not cause such a great density as that of the spark images obliterated. With prolonged exposure, radium rays reverse spark images.—*Phil. Mag.,* March.

REFERENCES.

Light and Electric Waves.—Braun.—An account of experiments in which he produced with ordinary light waves the effect produced by Hertz with a grating of parallel wires which is found to reflect electric waves vibrating in the plane parallel to the wires while it freely transmits those waves which vibrate at right angles to the wires. In his experiments he used wires disintegrated on a glass plate by means of a powerful electrostatic discharge.—*Sitzungsber. Akad. Wiss., Berlin,* January 21; abstracted in Lond. *Elec.,* February 19.

N-Rays.—Bichat.—An account of experiments made to find an explanation for the apparent anomaly that N-rays, being a form of radiation, may be "conducted" by a wire. The conduction is a case of successive reflection. Light may be similarly conducted along a curved glass tube. The transmission is really due to the wire and not to the medium in which it is placed. In order that the conduction may take place, it is necessary that the material of the wire should itself transmit N-rays.—*Comptes Rendus,* February 8; abstracted in Lond. *Elec.,* February 26.

Magnetic Effect of Convection Currents.—Gutton.—A description of a new method of proving the magnetic effect of convection. If a luminescent screen is placed on an earthed sheet of lead and an electrified ebonite rod is put underneath, then as long as the rod is at rest it exerts no influence; but if it is revolved about its own axis, the luminescence becomes temporarily greater. An unelectrified rod has no such action.—*Comptes Rendus,* February 8; abstracted in Lond. *Elec.,* February 26.

Electro-Chemistry and Batteries.

Constitution of Salt Solutions.—Abegg.—Hittorf has already shown long ago that cadmium chloride must contain in solution, besides the simple cadmium and chlorine ions, also complex ions formed by a combination of cadmium chloride with chlorine ions. From experiments made by Labendzinski, the present author concludes that such complex ions must be assumed to exist to a far greater extent than has been assumed to be the case, in acetates,sulphates and chlorides, and to a smaller extent in nitrates; the metals, the salts ofwhich were examined being zinc, cadmium, iron, cobalt, nickel, lead and copper. To the existence of such complex ions the author attributes the reason of the well-known disagreement between theory and practice in the case of Ostwald's law for the relation between conductivity and dilution.—*Zeit. f. Elektrochemie,* January 29; abstracted and commented upon in *Electrochem. Ind.,* March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct-Reading Ohmmeter.—SACK.—An illustrated description of a direct-reading ohmmeter of Siemens-Halske, which consists essentially of a milliammeter with revolving coil. With some storage cells and the unknown resistance to be tested it is connected in series. In order to get a suitable scale, that is, one with approximately uniform divisions, the pointer is arranged to be at open circuit beyond the scale and to enter the scale only when the tested resistance is smaller than the maximum ohms for which the instrument is calibrated. In order to prevent that when opening the circuit and pointer comes back with too high a speed to its zero point, arrangements are made so that when the tested resistance is disconnected, the instrument is at once connected to another resistance which corresponds to the maximum ohms for which the instrument is calibrated. The pointer goes to the beginning of the scale and the circuit may then be opened without danger. In order to make the reading independent of the voltage of the battery, a magnetic shunt is provided which by means of a screw can be pushed more or less over the poles of the magnet so as to vary the magnetic field strength at will.—*Elec. Rundschau*, February 15.

MISCELLANEOUS.

Electrical Engineering in Russia.—An account of the proceedings of the third Russian Electrical Congress which was held in St. Petersburg at New Year, more than 500 members being present. Kowalewski spoke on the utilization of the water powers. Nearly nothing has been done in this regard in Russia; while in Germany water falls are available to the extent of not more than 17,000 hp, in Russia up to about 15,000,000 hp are available. The congress adopted a resolution that the right of developing the power of rivers for electrical purposes belongs to the state, which may either develop the power itself or may sell the franchise to companies or private parties, which thereby obtain the right of expropriating the ground necessary for the plant. Lubenski discussed the application of electric traction on the Siberian Railway and thought that especially in Central Siberia for a length of 900 km. the use of electric traction would be profitable since in winter there are difficulties with steam traction. In the discussion which followed the economy of this project was questioned, since ice formation on the trolley wire might offer a great difficulty. Graftio spoke on the economical results of electric traction on railroads and the congress adopted a resolution in which the departments of commerce and finance were requested to have an investigation made of the utilization of the water falls of the Caucasus and near the Black Sea in order to electrify the railroads in the neighborhood. Kohan reported on the project of electric tramways in St. Petersburg. While no decision has yet been reached concerning the method of current supply to the cars, the general plan has been laid out of the road. The capacity has been calculated so that 264,000,000 passengers can travel per year. The length of the lines will be 315 km. A central station of 18,000 kw, with 6,000-volt, three-phase currents and eight sub-stations for 600-volt direct current have been projected, but it is not yet decided whether water power or steam engines or steam turbines shall be used. Popow spoke on wireless telegraphy. There are now in the far east of Russia 50 stations and it is possible to transmit messages from ships to the coast for the distance of 190 km.—*Elek. Zeit.*, February 18.

REFERENCES.

Engineering College.—A detailed illustrated description of the equipment of the Northampton Institute, its technical departments, the mechanical and electrical engineering and the applied physics departments and the various workshops and laboratories.—Lond. *Eng'ing*, February 19.

Austria.—An account of a meeting in which a union of the Austrian electric central stations was organized.—*Zeit. f. Elek.*, February 21.

Biographical.—An account, by Abegg, of the life and work of Savante Arrhenius, the founder of the electrolytic dissociation theory, with his portrait.—*Zeit. f. Elek.*, February 19.

Naval Wireless Telegraph School.

It is stated that the Navy Department is making preparations to transfer the wireless telegraph school for enlisted men from Newport, R. I., to the Navy Yard at New York.

New Books.

HIE EUROPA! HIE AMERIKA! By Julius H. West. Berlin: Siemenroth. 55 pages. Price, 1 mark.

The author of this book has endeavored to lay bare the reasons for America's economic superiority in the markets of the world. While much of his reasoning is not new, his book is very interesting because he discusses the subject from the standpoint of actual experience. Mr. West visited the United States on two occasions to study manufacturing methods. He himself spent several years in actual machine shop practice before becoming an editor of the *Elektrotechnische Zeitschrift*. His comparisons between European and American shop practice are very interesting. While in Europe the working man is not encouraged to make any improvements and is treated as an inferior, Mr. West found that in the United States every inducement is offered to the employee to make improvements resulting in lower cost of product. He earnestly recommends European manufacturers to change their present policy and follow the best American methods.

A Motor Driven Coin-Counting and Wrapping Machine.

BY EDWARD VAN WINKLE.

The accurate counting and the proper handling of a large number of coins is a heavy task and necessitates the employment of clerks and others for the purpose. Such persons, unless specially skilled in counting, often find it difficult to continue the work for any length of time without great fatigue, while errors are likely to arise because of miscount. A machine for this purpose is illustrated here-

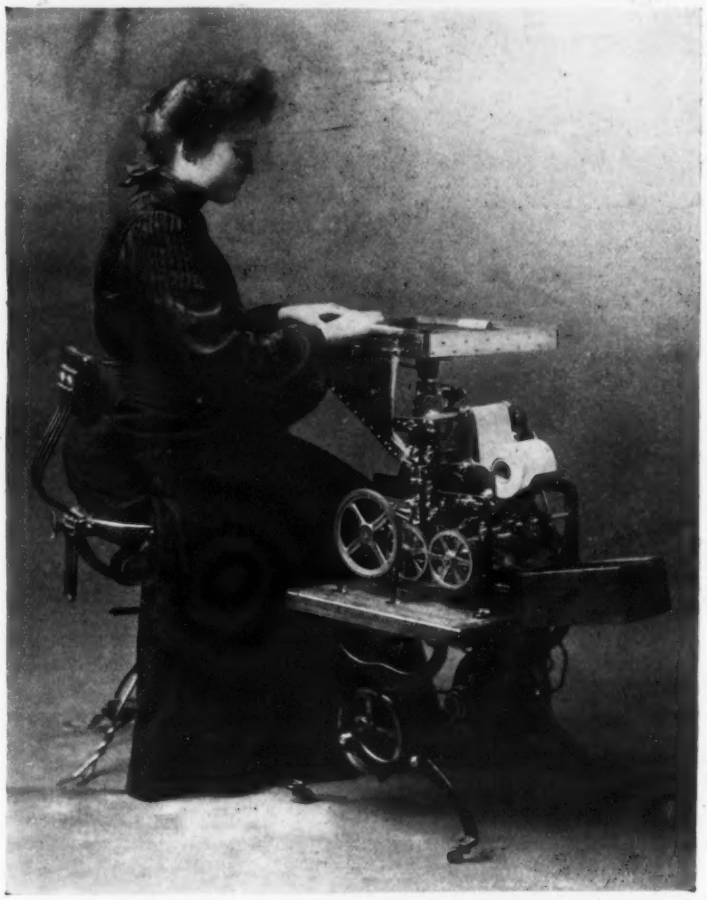


FIG. I.—MACHINE IN OPERATION.

with, which counts and wraps at the rate of seven coins a second or 420 coins (8 to 12 bundles) in one minute.

The immense saving of labor is at once realized by making a comparison to hand labor, which can as a maximum, provided no error in count occurs, count and wrap only one bundle per minute. This machine therefore will do the work of from eight to twelve men, without taking into consideration the loss in time if a miscount is found, with hand labor. The above speed is limited only by the examination of the coins by the operator, as they are fed into the ma-

chine from the table upon which they were first deposited. Experience has proven that 300 coins examined per minute is a safe and conservative limit which should be expected from the average operator.

It does not require any knowledge of machinery to run and operate the machine, as a small boy has proven to be as capable as any operator. The machine being entirely automatic, requires no attention.

By referring to the illustrations, Fig. 1 represents the machine in operation. Fig. 2 shows the machine in closed position with the coin conduit and box removed and table top swung around taking its position directly over the machine so as to protect it when not in use. A cover or hood may then be thrown over the machine to keep out the dust. Fig. 4 shows the product of the machine with the ends crimped like a cartridge, exposing the coin.

The coins are first deposited upon the table attached to the machine and then passed under the gauge by the operator, who re-

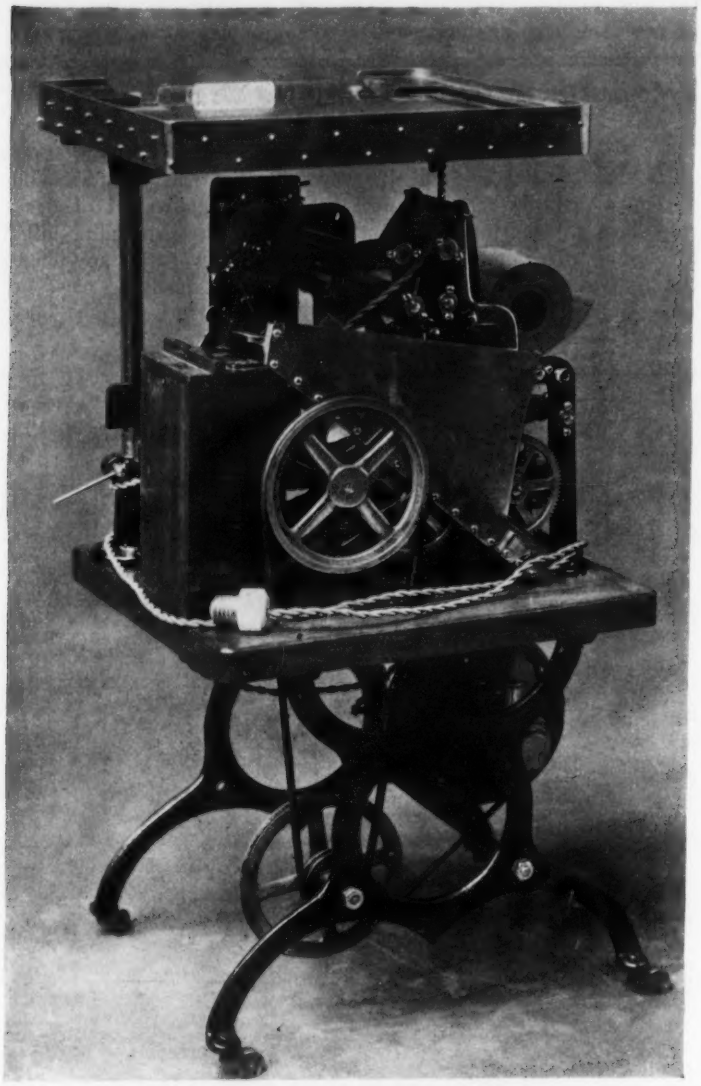


FIG. 2.—MACHINE IN CLOSED POSITION.

jects any mutilated or counterfeit pieces. They then drop into the conduit and are conducted by gravity to the machine, where they are each taken up separately regardless of thickness or diameter, advanced by the reciprocating push bar and assembled in a row ready to be wrapped. After the requisite number of coins are advanced, the registering of the final coin of the bundle sets in operation the wrapping mechanism, which is normally inoperative. The bunched coins are then transferred from the buncher to the wrapper by means of the holder, which then returns to its original position, ready to receive the coins of the subsequent bundle.

The bunch of coins while thus being transferred to the wrapping mechanism carries with it the end of the paper which has been fed in their path during the wrapping of the preceding bundle. Simultaneously, the lower coin roll is raised, forming a pocket with the two upper rolls into which the bunch of coins is carried, and the end of the paper is fed by friction between the three driving coin rolls and around the bundle of coins. The wrapper completely encircles the coins twice, giving strength and body for the crimp. The feeding of the paper around the bunch of coins tears the wrapper from the roll of paper by pulling the paper over a V-shaped knife, leaving its end, which serves for the final wrapping, cut with inwardly converging edges. The side edges of the wrapper are then turned inwardly by the crimpers, thereby drawing upon the converging edges in opposite directions and holding the final wrapping end of the wrapper closely and smoothly upon the rolled package without the aid of independent fastening, such as glue or paste.

The length of the package is determined by the thickness of the coin, which varies considerably. The crimp is always brought up

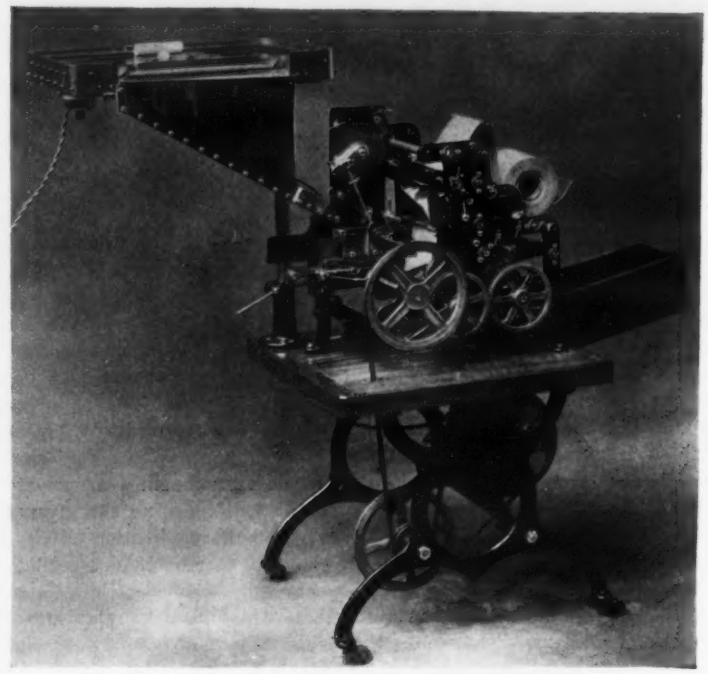


FIG. 3.—COIN-COUNTING AND WRAPPING MACHINE.

tight to the coins by the crimpers, which are drawn together by means of a right and left-hand screw. When the crimp is complete the cartridge is thrown out of the machine into a box, which is detachable and may be filed away in a safe or vault, thus minimizing the labor in handling the coins. The package of coin when shot out of the machine is so securely wrapped that no one coin can be extracted without destroying the entire package, thus making it impossible to cheat the machine.

The machine is operated by an electric motor, and as it consumes but three-tenths of an ampere at 110 volts, it is easily attachable to any standard light socket by means of a connection plug. It is started and stopped by a turn of a button switch.

It will be noticed that the paper is fed into the machine from the under side of the roll, which is in plain view in Fig. 1. In this position the curl of the paper due to the roll helps the wrapping of the package and makes it possible to neatly crimp the ends, as shown in Fig. 4. If fed from above, as was the case when the machine came to attention for development, the crimper, in addition to its own work in crimping the ends of the package, had to overcome the curl of the paper, and the crimped ends were therefore an impossibility. Simple changes like the above made this machine possible.

It may be interesting to look into the history of this coin-counting and wrapping machine and its development. The writer while exhibiting of these machines at Washington, had a long talk with the Patent Examiner, who said that he could not account for the fact that the counting and wrapping of coins by machinery had not been patented before, unless the fact that inventors as a rule did not have any money to count, and consequently their minds did not run that way. As the inventor of this machine had been connected with a "penny-in-the-slot" machine company and was dependent for his living upon returns from several of these vending machines, his revenue was all in coin and he came to dislike the sight of it. He had three nail kegs in his room in which he deposited his daily collections, and perchance if he wanted to pay some bills by check, he and

his family would have to stay up all night counting and wrapping these coins so that he could deposit the same in the bank.

His wife suggested in jest one evening, while his family were industriously wrapping coin in order to swell his bank account sufficiently to pay his rent, that he "invent a way to count coins by machine and thus save this distasteful hand labor." He gave considerable thought to the idea, and developed at first a crude device which he patented and afterwards found out could not be made to work. His idea was to give rotating motion to the coins by means of a loose belt, forming a pocket instead of the three rolls as now used. He had planned to shear off the paper with sharp knives and glue the paper around the coins and fold the ends, as now accomplished by hand wrapping. His original patent called for a printing device which printed on each package the face value of the coins with each wrapping. The ideas were found to be impractical, as the knife blades would dull, and if the machine was allowed to stand the

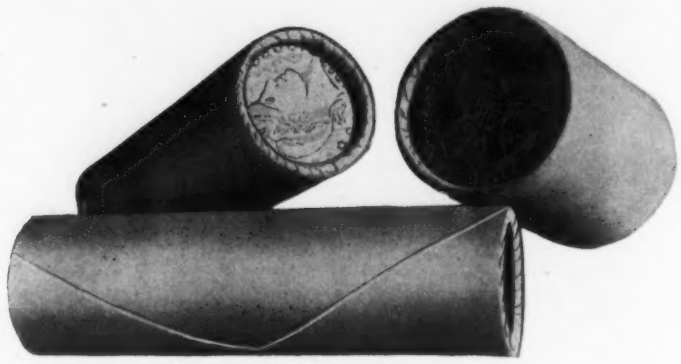


FIG. 4.—PACKAGES OF COINS.

glue would become hard and the ink dry. The loose belt would throw the coins on the floor and was found most unreliable; the idea was therefore abandoned.

With the coin exposed at each end of the package it is not necessary to print the value of the coin on the wrapper. However, when required, the printing can be done before the paper is put into the machine. Each wrapper, in length, is equal to twice the circumference of the coin which it wraps and the printing is spaced, a distance equal to half the length of the wrapper, from one end of the roll of paper to the other; thus it matters not where the wrapper is cut off the roll, as only one printing is visible on the package.

The length of the longest wrapper is 7¾ inches and is 2⅜ inches wide. This size is used to wrap twenty-five cent pieces. The length of the shortest wrapper is 4⅛ inches long and is 2⅞ inches wide and used for fifty ten-cent pieces. The economy of paper is only realized when one tries to wrap the coins by hand in a wrapper automatically cut off by the machine.

Westinghouse and the British Trade Union.

The British Westinghouse & Electric Manufacturing Company, Limited, whose colossal works at Trafford Park, near Manchester, are now in full swing, and give employment to more than 6,000 hands, have agreed to the insertion of the "fair wages" clause in their municipal contracts and are joining the British Employers' Federation, thereby undertaking to abide by the working terms mutually agreed upon by the Federation and the trade unions. Thus, once and for all, American terms of employment, which were aimed at when the company was first organized, have gone by the board.

H. S. Loud, the general manager of the Westinghouse works, according to advices received here, states that the "fair contracts" clause of the Manchester Corporation has been the main factor in bringing about the decision. The company tendered recently for a substantial contract, which was duly secured, with the tramways department of that city and at a certain stage of the negotiations the question of signing the clause came up. Practically it was a question whether the company would accept the clause or run the risk of losing a valuable contract.

The concession which the British Westinghouse people have made is the outcome of prolonged negotiations. In Pittsburg it is the custom to pay time and one-half for all overtime, and this was what the British company began to do at Trafford Park. But the British trade union rule is time and a quarter for the first two hours of overtime, time and a half for the second two hours and double time for the third two hours. The company tried to show the trade unions that the Yankee method was the more advantageous, but the unions were unconvinced and the company yielded the point.

Another dispute between the company and the unions was in reference to the working hours of the night shift, but this has been amicably settled and now that the company has accepted the terms of the "fair wages" clause the last bone of contention is buried.

Electric Power in Gold Dredging.

BY C. WESTON CLARK.

The first gold dredgers in California were operated by steam, but expensive operating made them successful only when rich ground could be worked. With cheap electric power, dredging land averaging less than 10 cents a cubic yard is made profitable. The gold-carrying soil varies from 10 to 50 ft. in depth, being a gravel deposit left in old river channels.

The two types of electric dredges which have been used secure the soil by either lifting it through centrifugal pumps or by an endless chain of buckets. The latter system seems to be the most favorable. A boat is built in a pit where it is to be operated, and the necessary machinery placed aboard. The pit is then filled with water to a depth of from 25 to 40 ft. The boats are fed by a cable about 500 ft. long, which runs from the shore to the boat. Generally these cables are arranged for three-phase, 60-cycle current standard low voltage, but one or two of the boats are fed by a 4,000-volt, four-wire cable, which is carried directly to the boat and the ore transformers placed on the boat. The lower voltage cables are rubber insulated and triple-braid water-proof. The 4,000-volt cables are leaded and armored. The transformers are sometimes placed on the boat and sometimes on a pole near the boat. Usually the latter arrangement.

The dredger digs its own channel ahead of it, depositing the soil

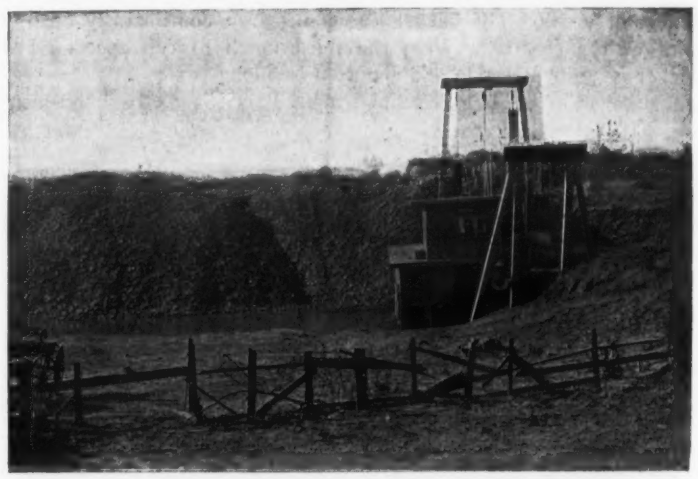


FIG. 1.—DREDGE "HEAD ON."

which has been worked behind it. The soil is elevated into a grizzly or similar screening device where the rocks are washed from the soil, the rocks being delivered to the carrier that deposits them out of the way behind the dredger. The soil is then washed through shakers and riffles, leaving the gold deposited on saving tables to be taken up with quicksilver, and the worked-over soil is run out at the stern of the boat. The General Electric Company, Schenectady, N. Y., has developed electric equipments for such machinery of all kinds, and the electrically-operated dredges recently equipped by that company are splendid examples of successful engineering enterprise.

A typical outfit recently sold to the Western Engineering & Construction Company for the Central Gold Dredging Company, of Oroville, consists of the following induction motors: One 50-hp motor, with controller and resistance for driving the bucket line; one 15-hp motor, with controller and resistance for operating the winches (this apparatus is for working the head lines and changing the direction of the boat to suit the work); one 40-hp motor, direct-connected to a centrifugal pump (this pump furnishes water for washing the soil); one 15-hp motor to drive the stacker or conveying belt which

disposes of the stones; one 15-hp motor for operating the shaking screens; one 30-hp motor for operating the sand pump (this motor is worked occasionally when the sand accumulates too thickly at the back of the boat, and delivers it out on the rock pile through a long pipe); one 3-hp motor for operating a deck and bilge pump, used for general washing purposes. The buckets each carry 3 cubic feet of earth. A similar equipment of the chain bucket type is furnished the Butte Gold Dredging Company. This has 85 buckets to the chain, each bucket having a capacity of 5 cubic feet, and being oper-

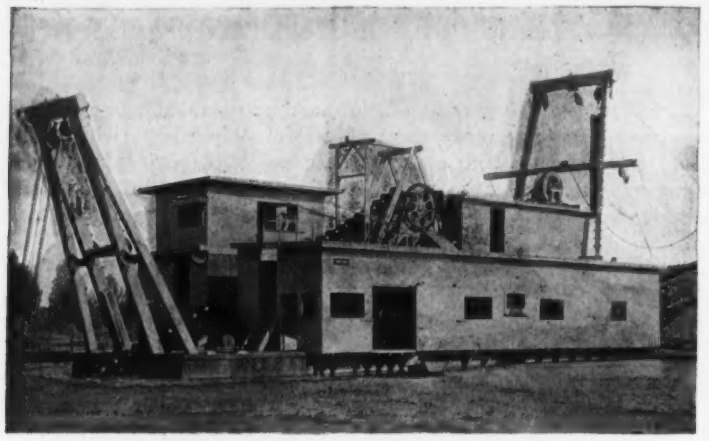


FIG. 2.—DREDGE WORKING SAND PILE.

ated at a normal speed of 22 buckets per minute. The dredge will dig from 50,000 to 75,000 cubic yards of material per month. There are some dredges using a 3½-cubic-foot bucket which will not exceed 50,000 cubic yards per month. The standard dredge, however, uses the 5-foot bucket. This dredge has a hull about 36 by 90 feet on the water line, with a draft of 5 feet. It is fitted with two spuds —one wood, 50 feet long, weighing about 10 tons; one steel, 50 feet long, weighing about 17 tons. The swing permits of a cut about 90 feet in width. The bucket line can be run continuously on any point of the controller from the third notch to full speed. The stacker is 30 inches wide and about 90 feet long.

A number of other successful installations equipped by the Gen-

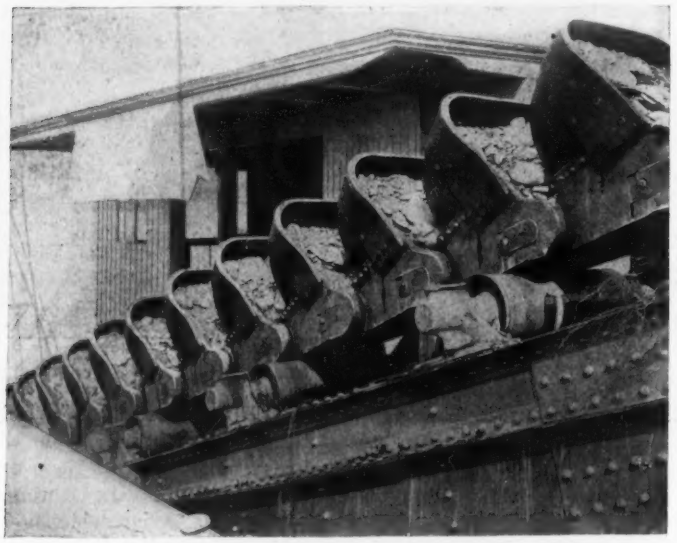


FIG. 3.—BUCKET LINE.

eral Electric Company on these lines could be mentioned. Among them are plants for the Yuba Consolidated Dredging Company, the Folsom Development Company, the Boston & Oroville Gold Dredging Company, the Oroville Gold Dredging & Exploration Company, the El Oro Gold Dredging Company, and the Ashburton Mining Company. There are now about 40 dredgers working in California with more to come.

Portable Voltage and Series Transformers.

The ordinary equipment for making electrical measurements affords chances for error which care cannot always overcome. It is frequently impossible to have at command instruments of all the capacities required to give the best results. Readings should be taken well within the range of the instruments, upon the portion of the scale where the divisions are large and open and errors in observation not likely to occur. Even when instruments of all the desired ranges are at hand, it is still often difficult to obtain absolute accuracy and uniformity of results, owing to the variations in the different instruments which make it impossible to check up the results obtained.

In checking and testing electrical instruments with the use of the ordinary appliances, the standards often present the same difficulties and make it impossible to certify absolutely to the accuracy of the results obtained. In fact, the greater number of the errors and discrepancies in tests can be traced directly to lack of legibility of standards and to variations in the different instruments.

Manifestly, the ideal instrument either for taking measurements or for making comparisons with other measuring devices is one which will combine a great degree of legibility with a capacity for all ranges in which readings are to be taken, and any means by which these

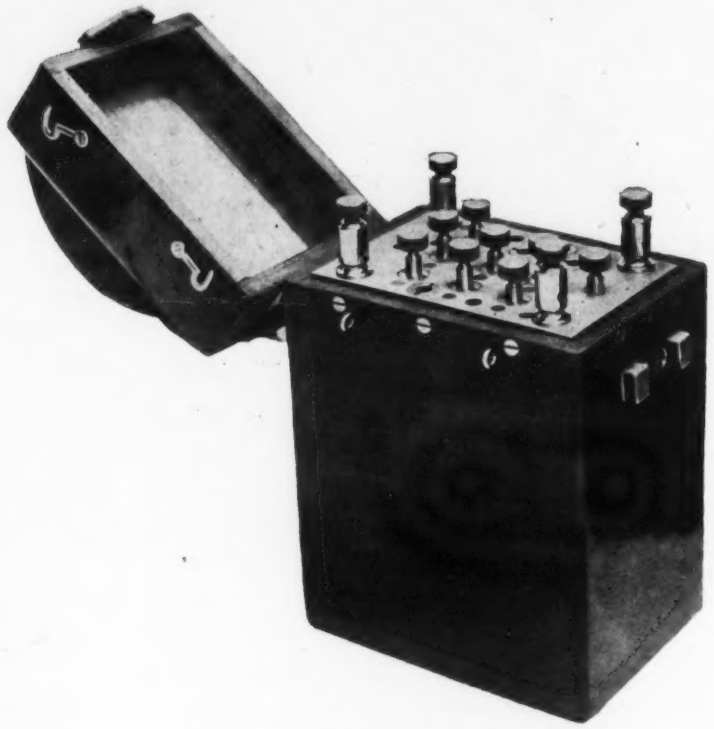


FIG. 1.—PORTABLE TRANSFORMER.

characteristics can be imparted to the instruments now in service is of practical value.

The best method for accomplishing the desired result is by the use of transformers which will adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be taken from the most legible portions of the scale. By this means any difficulty in readings is obviated, uniform accuracy at all capacities is assured, and a single voltmeter, ammeter and wattmeter will fulfil all the requirements of the most exacting service.

Portable series and voltage transformers made by the Westinghouse Electric & Manufacturing Company and shown in the accompanying illustrations are especially designed for this work. They are carefully made, the ample insulation and generous amount of iron and copper used reducing to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary, by the ordinary type of portable instruments, the output of the voltage transformer being about .15 amp. and the maximum voltage across the secondary of the series transformer being about three volts.

The series transformer is made in two types. In one, Fig. 1, designed for primary currents up to 100 amp., the ratio is changed by plugs, somewhat as in the Wheatstone bridge. In the other type, which is designed for larger capacities, there is a circular opening through the transformer, and the conductor is passed through this opening, forming the primary. In this type the ratio is changed by the number of turns made by the conductor; passing it through the aperture once gives a ratio of 400 to 5, twice a ratio of 200 to 5, and four times a ratio of 100 to 5.

The voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be ob-

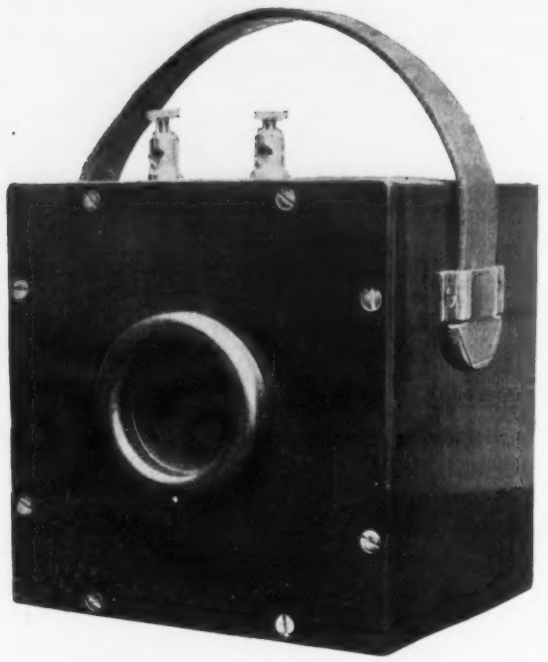
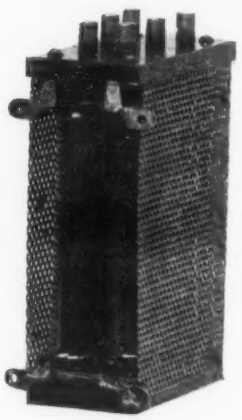


FIG. 2.—PORTABLE TRANSFORMER.

tained, although they are not usually required in a great range of capacities, as is the case with series transformers.

These transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover, which, for convenience in use, is made removable.

Quadruplex "Leak Boxes."



"LEAK" BOX.

The Ward Leonard Electric Company, of Bronxville, N. Y., is building a large number of quad. leak boxes for the Postal Telegraph Cable Company, which have the following features: The resistance consists of five Postal units (6½ in. long by 1⅛ in. in diameter) which can be readily taken out and new ones of different resistance inserted, if desired. The resistance wire is of a special alloy, which has a practically zero temperature coefficient. The resistance wire and the joint between it and the large lead wire are thoroughly covered by enamel, which hermetically seals them from the atmospheric conditions of moisture, etc.

The Postal Telegraph Cable Company has found that resistance lamps and cotton-covered insulator coils of resistance are not electrically perfect nor are they permanent, for the reason that, in the case of the lamp resistances the filament deteriorates and that even when new the resistance is variable with the temperature of the filament, due to the passage of current. In the case of the cotton-covered wires, more than one layer is necessary to obtain the proper resistance in a limited space, which leads to the result that upon the passage of current the inner layers are at a high temperature, heat from which cannot be readily dissipated, etc., and the insulation of the inner layers becomes charred and burned off. Mr. Francis W. Jones, head of the engineering department of the Postal Telegraph Cable Company, has suggested the design of these boxes and has paid particular attention to the special type terminals, which consist of nuts and washers, with the necessary lock nuts, etc., so arranged that not more than one nut can be moved at one time and when once locked can never become unlocked of itself.

Big British Westinghouse Contract.

The British Westinghouse Electric & Manufacturing Company, Limited, has recently secured the most important contract ever awarded in Great Britain for the installation of a light and power system for dock use. The value of the contract is in the neighborhood of $350,000. The Midland Railway, which operates one of the principal steam roads on the other side, is expending some $18,000,000 in the construction of docks at Heysham Harbor, Morecambe Bay, Lancashire, which will be used in connection with the company's Irish steamship service.

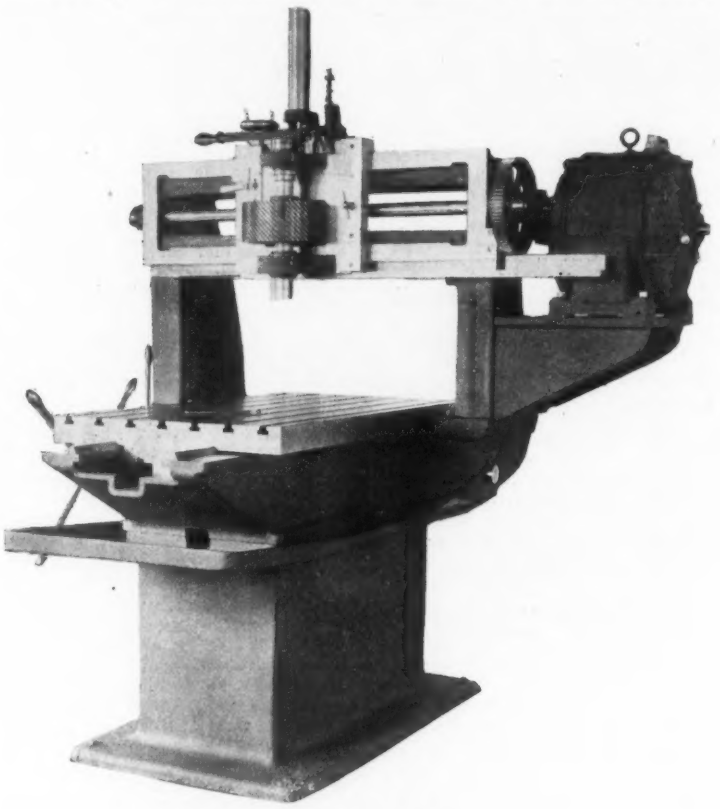
The initial equipment of the power plant will be somewhat over 1,000 hp. There will be three 350-hp Westinghouse gas engines direct-connected to Westinghouse generators of 250-kw capacity each. The gas engines will operate on Mond producer gas. There will be 500 kw more generating equipment added to the plant shortly. The cranes will be 28 in number. There will be one of 100-tons capacity, ten of 5-tons capacity, five of 2-tons capacity and twelve platform cranes.

Another interesting contract obtained by the British Westinghouse interests calls for the motor equipment for 200 additional cars for the Manchester Corporation electric traction system. Each car will have two motors of 35 hp each.

Motor Driven Profiler.

The machine illustrated herewith was built for finishing the bevel edges of irregular-shaped retort doors, and shows how readily the electric drive can be adapted to this class of tool. The spindle is driven by spiral gear and pinion from a spliced shaft and the wide face of the spindle gear permits the up and down adjustment.

The cross slide is moved by vertical rack pinion shaft contained in the right-hand upright and connected with a pilot wheel at the side of the bed. The large table is also moved by pilot wheel, the two



MOTOR-DRIVEN PROFILER.

wheels being located close together, so that all necessary movements in following an outline are controlled from one point, from which the cut can be seen at all times. The movements of the machine are by hand as is necessary in following the outline of the model.

The spindle runs in bronze cap boxes and the slide is balanced and fitted with micrometer lock notch stop and screw gauge stop. The table feeds 46 in., clear height 6 to 13 in., clear width 25 in. The weight is 4,500 pounds. The maker is the Garvin Machine Company, New York.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The market was very dull throughout the week, and the volume of business done was exceedingly small—in fact, the smallest for almost ten years. Business from commission houses was entirely lacking and the professional operations were quite insignificant. Toward the end of the week there was a little improvement in point of activity, but it was almost entirely at the expense of prices. The week was entirely devoid of any striking incidents in connection with the share list. The Steel shares were quiet and firm, and the traction group was irregular. Some weakness developed toward the close of the week in Metropolitan Street Railway, the closing price—106⅞—being 7⅛ points below that of the previous week. Brooklyn Rapid Transit lost ⅜, closing at 39½. The electric group also suffered losses, General Electric closing at 159½, being a net loss of 1½, and Westinghouse at 157, a loss of 8 points. Western Union was the exception, making a net gain of ½ point, the closing price being 88½. The curb market was somewhat irregular and reactionary, in sympathy with the Stock Exchange, and the volume of business was small. Electric Boat preferred made a net gain of 2 points, closing at 54, ex-dividend 2 per cent. Following are the closing quotations of March 15:

NEW YORK.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Tel. & Cable	85	84	General Electric	160	162¼
American Tel. & Tel.	121	121	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	113⅛	107⅞
Brooklyn Rapid Transit	40¼	41¼	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	185	180	N. Y. & N. J. Tel.	..	..
Electric Boat	23	22	Marconi Tel.	..	..
Electric Boat pfd.	53	52	Western Union Tel.	88	88⅛
Electric Lead Reduction	⅛	⅛	Westinghouse com.	157	159
Electric Vehicle	7⅛	7⅛	Westinghouse pfd.	180	175
Electric Vehicle pfd.	10	10			

BOSTON.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Tel. & Tel	121	122	Western Tel. & Tel. pfd.	79	78
Cumberland Telephone	114¾	115	Mexican Telephone	1¼	1⅛
Edison Elec. Illum.	*235	234	New England Telephone	118	118
General Electric	161	162	Mass. Elec. Ry.	18	18
Western Tel. & Tel.	8⅛	8⅛	Mass. Elec. Ry. pfd.	73	71½

PHILADELPHIA.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Railways	43	42½	Phila. Traction	97¼	..
Elec. Storage Battery	52	52	Phila. Electric	5¾	5⅞
Elec. Storage Battery pfd.	52	52	Phila. Rapid Trans.	14	13½
Elec. Co. of America	7¾	7⅞			

CHICAGO.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
Central Union Tel.	..	..	National Carbon pfd.	98	97½
Chicago Edison	..	..	Metropolitan Elev. com.	15¼	14
Chicago City Ry	156	156	Union Traction	4½	5
Chicago Tel. Co.	..	..	Union Traction pfd.	30⅛	30
National Carbon	26¾	25			

*Asked

WESTERN UNION FIGURES.—The Western Union Telegraph Company reports for the quarter ended March 31, 1904 (partly estimated):

	1904. (Estimated.)	1903. (Actual.)	1902. (Actual.)	1901. (Actual.)
Net revenue	$1,750,000	$1,842,269	$1,592,218	$1,504,226
Bond interest	286,300	286,300	254,770	239,040
Balance	$1,463,700	$1,555,969	$1,337,448	$1,265,186
Dividends	1,217,017	1,217,014	1,217,008	1,217,001
Surplus	$246,683	$338,955	$120,440	$48,185
Previous surplus	14,360,346	12,176,386	10,209,866	8,964,710
Total surplus	$14,607,029	$12,515,341	$10,330,306	$9,012,895

The above partly estimated statement gives the approximate figures for the nine months of the fiscal year (July 1 to March 31) as compared with the actual figures of the three preceding years:

	1904.	1903.	1902.	1901.
Net revenue	$6,097,256	$6,206,773	$5,399,852	$4,922,812
Bond interest	858,900	791,400	737,810	717,120
Balance	$5,238,356	$5,415,373	$4,662,042	$4,205,692
Dividends	3,651,051	3,651,035	3,651,022	3,651,002
Surplus	$1,587,305	$1,764,338	$1,011,020	$554,690
Previous surplus	13,019,724	10,751,003	9,319,286	8,458,205
Total surplus	$14,607,029	$12,515,341	$10,330,306	$9,012,895

BROOKLYN RAPID TRANSIT.—The statement of Brooklyn Rapid Transit for the calendar year 1903 showed a surplus after charges of $1,138,225, compared with a surplus of $964,878 for the fiscal year ending June 30, showing an increase of $173,347, or 17.9 per cent. The surplus for the calendar year is equal to 2.5 per cent. on the $45,000,000 stock. The following table compares operations of the calendar year and the fiscal year 1903:

	Cal. year.	Fiscal year.	Increase.	Per cent. inc.
Gross	$14,025,825	$13,280,321	$745,504	5.6
Expenses	8,392,607	7,931,079	461,528	5.8
Net	$5,633,217	$5,349,242	$283,975	5.3
Other income	207,512	277,493	*69,981	*2.5
Total net	$5,840,739	$5,626,735	$214,004	3.8
Charges and taxes	4,702,513	4,661,857	40,656	0.8
Surplus	$1,138,225	$964,878	$173,347	17.9

*Decrease.

The increase in gross for the six months is proportionately less than the increase during the last fiscal year, which was 6.15 per cent. The operating ratio is 60 per cent. of gross earnings, compared with less than 50 per cent. for Manhattan and Metropolitan.

FAIR HAVEN TROLLEY DEAL.—The basis of the merger of the Fair Haven & Westville Trolley Company with the New York, New Haven & Hartford is understood to be the exchange of 50-year 3½ per cent. debentures for the Fair Haven & Westville stock, the latter being taken at a valuation of $50 for each share of par value of $25. The shareholders of the Fair Haven & Westville thus get 7 per cent. on the debentures in place of the present 5 per cent. dividend on stock. The merger will call for the issue of about $9,600,000 of New Haven debentures to take up the outstanding trolley stock or stock to be created April 1. By the merger the New Haven obtains about one-fifth of the whole trolley mileage in the State of Connecticut. This trolley road is the second largest single system in the State of Connecticut, and for a time was considered as a probable nucleus of an electric system between New York and Boston, paralleling most of the New Haven. Its purchase now by the New Haven will prevent any such scheme. Following the acquisition of the Fair Haven & Westville comes the report that the New Haven is negotiating to buy the Connecticut Railway and Lighting Company's lines in Connecticut, owned by the United Gas Improvement Company of Philadelphia.

NEW WESTERN ELECTRIC FACTORY.—Note has been made from time to time of the large new Western Electric factory in the suburbs of Chicago. It is said that one of the principal objects of the Western Electric Company in establishing a large factory and warerooms in the suburban district is to provide space for a large supply department sufficient to supply all the Bell telephone companies of the United States with material at the lowest price and to carry on hand large stocks of the standard goods, thereby obviating the necessity of the various companies carrying a larger stock of supplies than that actually needed. This massive storehouse and purchasing agency will be in charge of a competent person, who will do the buying for all the Bell telephone companies of the country. At present it is estimated that the several companies of the country have invested in unused supplies at least $10,000,000; under the new arrangement this can be reduced from 50 to 75 per cent. By purchasing in large quantities and distributing as wanted considerable money could be saved. This plan will, it is asserted, be put into operation as soon as the buildings are completed.

FEDERAL TELEPHONE.—The appended statement shows comparative earnings of eight of the subsidiary companies of the independent Federal Telephone Company for the months of January, 1903, and 1904. The companies included in the statement are the Cuyahoga, Findlay, Fostoria, Youngstown, Zanesville, Lancaster, Massillon and Stark County:

	1904.	1903.
Gross	$46,559.89	$44,594.44
Net	21,730.35	19,772.09
Surplus	8,590.75	7,722.23

ELECTRICITY FOR MEXICAN STEAM ROAD.—Mexico City advices state that the Mexican Railway has applied to the Secretary of Public Communications for the necessary permission to establish electric traction on the section of its road known as Las Cumbres de Maltrata, where the heavy grade requires two locomotive to haul an ordinary passenger train. The current will be generated at a large fall on the Atoyac River. The government authorities have commissioned Armando Santa Cruz to examine this waterfall and report as to the electric power it can produce.

DIVIDENDS.—The Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent. on the preferred stock and a dividend of 2 per cent. on the common. The directors of the Safety Car Heating & Lighting Company have declared the regular quarterly dividend of 2 per cent. and an extra dividend of 1 per cent., payable April 1. The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent., payable April 1. Books close March 15 and reopen April 2. Westinghouse Air Brake directors have declared the regular quarterly dividend of 2½ per cent. and 2½ per cent. extra, payable April 11. The previous extra dividends were 3½ per cent. The regular quarterly 1 per cent. dividend on International Steam Pump common is payable April 1.

J. A. FAY & EGAN.—The annual report of the J. A. Fay & Egan Company shows net earnings of $324,000, with a surplus of $172,000, for the year after all dividends and charges. These figures represent the largest year's business in the history of the company. Fred. T. Egan has been elected a director of the J. A. Fay & Egan Company in place of Albert N. Spencer, who retires as director and second vice-president. The following were elected officers of the company: Thomas P. Egan, president; S. P. Egan, vice-president; W. M. Green, secretary; A. A. Faber, treasurer; Joseph Rawson, F. H. Simpson, Rudolph Klybolte, L. G. Robinson, J. E. Bruce, W. H. Doane and Fred. T. Egan additional directors.

NEW "SOO" COMPANY.—It is stated officially that the Consolidated Lake Superior reorganizers contemplate making C. D. Warren, president of the Traders' Bank and of the Metropolitan Traction Company, both of Toronto, president of the reorganized Consolidated Lake Superior Company. T. J. Drummond is slated for the vice-presidency. The New York banks have already consented to the change in the personnel of the Canadian Improvement Company, and it is stated that all of the Philadelphia banks have promised to sign.

MISSOURI & KANSAS TELEPHONE COMPANY.—The Missouri & Kansas Telephone Company (an American Bell licensee), reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$1,303,795	$1,228,436	$1,056,638	$863,235
Expenses	1,039,717	956,993	814,790	665,132

SAFETY CAR HEATING & LIGHTING.—The statement of the Safety Car Heating & Lighting Company for the year ending December 31, 1903, shows as follows: Net profits, $870,419, against $626,182 in 1902; paid out in dividends, $639,445, against $491,084; surplus, $230,974, against $135,098.

BELL TELEPHONE STOCKHOLDERS.—The number of stockholders of the American Telephone and Telegraph Company is now in excess of 16,500. Through the last increase in the company's outstanding stock, amounting to about $21,000,000, the number of stockholders was increased by about 3,000 names.

TROLLEY BONDS.—It is stated from Toledo that the Lake Erie, Bowling Green & Napoleon Electric Railway Company has issued and sold $1,000,000 5 per cent. thirty-year gold bonds, the money to be used to extend the present line to Fort Trenton and Napoleon.

Commercial Intelligence.

THE WEEK IN TRADE.—The conditions in trade throughout the country are much improved, due largely to the more favorable weather. Spring trade is "looking up" everywhere, and life is taking the place of the inactivity and dullness that prevailed generally through the effect of the prolonged cold weather. In the iron trade there is increased activity, and the prices of crude material are stiffer. The transportation situation is much improved, and the railway gross earnings for February promise to make a better showing than was anticipated. From many cities come complaints of collections notwithstanding the easy market and low prices for money. Reports from the South indicate an enormous acreage in cotton, and the reports of trade in most all lines are full of encouragement. Figures of iron production and stocks show that notwithstanding a large increase in the output, supplies on hand are smaller than during the winter. Finished products are also more active, and increased business is reported. From all parts of the country come details of much activity in agricultural implements. The copper market was inactive and extremely dull and transactions were very few. The prices quoted on the Mutual Exchange are 12½ to 12¾c. for Lake, 12⅜ to 12⅝ for electrolytic and casting stock. The London market was of the same character as that in New York. The business failures for the week ending March 10, as reported by Bradstreet's, numbered 200, an increase of five over the week previous, while those in the corresponding week last year numbered 176.

POWER TRANSMISSION IN IDAHO.—The Moscow Electric Light & Power Company, Moscow, Idaho, have made arrangements with the Lewiston Water Power Company to furnish them with 1,000 hp for distribution in the territory north of the Clearwater River. This power will be generated by a large water-power plant to be installed at the mouth of the Grand Ronde River and will be taken to Moscow, Genesee and other towns at a pressure of over 20,000 volts on a three-phase circuit. The current will be furnished twenty-four hours in the day. It is expected that power can be delivered in Moscow and Genesee by July 1, as construction work will begin by April 1 on the lines from Lewiston, and power will be supplied from the present plant of the Lewiston Company at Asotin until the large plant at the Grand Ronde can be installed. Engineers and surveyors have been at work on the plans since last fall and a plant will be installed that will cost nearly $1,000,000. Twenty-five thousand hp can be developed at the proposed plant, so there will be plenty of power to supply all that will be needed for some time to come. It is reported that a contract has been made with the large Word Flouring Mills at Genesee for power to run their mills and elevator twenty-four hours per day and also with the city for lighting the streets and pumping the water for the new waterworks plant to be installed this summer. Mr. M. J. Shields, president, and Mr. E. S. Aldrich, manager of the Moscow Electric Light & Power Company, state that they have been negotiating with Mr. Libby, of the Lewiston Company, for nearly a year, and have every assurance that the current can be delivered in Moscow by not later than August 1 of the present year. They also state that they will be able to save the city of Moscow at least 25 per cent. in pumping the city water, which will amount to a large sum when the new sewer system is put into operation as it will require at least double the water to be pumped that is being pumped now. The present steam plant will, of course, be held as a reserve power, but it is not expected that it will ever be needed as current has been on the lines of the present plant ten miles from Lewiston all the time for eighteen months and only one interruption of ten minutes has occurred.

ALLIS-CHALMERS DATA.—A great deal of interest is naturally being taken in the electrical field, in the advent of the Allis-Chalmers Company into it, not only as builders of reciprocating engines and other heavy mine and mill machinery, but of steam turbines, hydraulic turbines, gas engines and electrical apparatus. The acquisition of the Bullock Electric Manufacturing Company has also again attracted attention, as putting the company in line for immediate work of all kinds, including street railway motors. The capital stock issue of the Allis-Chalmers Company is $36,250,000 and of the Bullock Company $3,600,000, making a combined capital of $39,850,000. The total number of employees of the combined companies amounts to over 8,700 men. At the present time Allis-Chalmers are constructing for the Manhattan Elevated Railway system of New York about 100,000 hp in reciprocating engines having a capacity of from 3,000 hp normal to 12,000 hp maximum output. A duplicate of this important station is also being constructed for the Subway, New York.

ELECTRICAL EXPORTS.—The United States Department of Commerce and Labor has issued the figures in detail of January export trade. The total export of electrical machinery for the month was $455,091, as compared with $556,315 last year, while the total for the seven months was $2,892,251, as compared with $3,668,432 last year. The smaller demand was chiefly in England, where the amount was $875,431, or hardly one-half what was taken in 1903. The exports of electrical instruments of all kinds were $375,044 for the month, as compared with $239,234 in 1903. For the seven months the total was $3,177,106, as compared with $2,496,368 last year. The two items added together show $6,069,357, as compared with $6,164,800, so that on the whole the electrical export trade has been fully maintained despite the growth of American factories abroad.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, has recently greatly increased its manufacturing output in order to meet the heavy demands for the new telephone apparatus it is putting on the market. It has equipped its factory with considerable new machinery, including a number of large drill presses and full automatic Brown & Sharpe screw machines. The International Company has a full complement of special tools for manufacturing every distinct part of multiple switchboard central energy systems and generator-call exchange systems, including its improved self-restoring drop switchboard. Several recent heavy contracts are reported.

ILLINOIS TELEPHONE TUNNEL.—It is stated that President A. G. Wheeler of the Illinois Tunnel Company, which recently took over the assets of the Illinois Telegraph & Telephone Company, announces that bids for about 2,000 steel freight cars, to be operated in the tunnels underneath the downtown streets of Chicago, will be asked about March 15. Tentative operations are now being carried on in the tunnels where about twenty cars are already in service. Many of the large buildings and wholesale houses lying along the route of the tunnels are having connections cut into their basements. They will be ready to receive and deliver goods and supplies to and from railroad terminals and freight depots by July. President Wheeler also announces that since the preliminary work of the big tunnel company has been completed, the telephone plan will be pushed more vigorously. The company now has in the neighborhood of 5,600 automatic telephones in operation in the business district. Practically all business blocks have been wired for the new service and Mr. Wheeler expects that the present number of subscribers will have been doubled by July 1.

BELL TELEPHONE.—Boston advices say: "President Fish, of the American Telephone and Telegraph Company, during his recent Western trip, found the general business conditions of the Far West to be extremely satisfactory. There is no sign there of the distrust that is such a disturbing element in the East. The conditions of the Middle West are also favorable and the people confident. In Mr. Fish's opinion, the optimistic views of the West, which are justified by the situation there, will have a great influence in bringing about the restoration of normal financial conditions at a much earlier date than would be the case if the West shared to a greater extent the present somewhat unreasonable feeling of depression that seems to characterize the East. Mr. Fish reports the telephone situation as everywhere encouraging. About a quarter of a million new subscribers were added to the Bell system during the year 1903, and the growth still continues. The development on the Pacific coast is extremely satisfactory, the number of telephone subscribers there being enormously greater in proportion to the population than in any other part of the country."

SOME BUFFALO FORGE COMPANY ORDERS.—The Buffalo Forge Company, 39-41 Cortlandt Street, has secured a contract from the American Coke and Gas Company, of Pittsburg, for a small lighting equipment for one of its Ohio plants. The Buffalo vertical engine will be direct connected to a Westinghouse generator. Blackall & Baldwin, Taylor Building, New York City, have also placed an order for a small lighting set for use in William Crafts & Company's plant at Newark, N. J. The generator will be of Crocker-Wheeler manufacture. A small ventilating outfit has been ordered for the Hotel York, Thirty-sixth Street and Sixth Avenue. The motors will be of General Electric build.

EQUIPMENT FOR NEW GORHAM PREMISES.—The Gorham Manufacturing Company's new premises, at Thirty-sixth Street and Fifth Avenue, New York, are to be installed with several electrically operated pumps, fans, etc., in connection with the heating and ventilating system. There will be two 1½-in. Buffalo centrifugal pumps and two 5-in. x 8-in. triplex pumps of same build, direct connected to Crocker-Wheeler motors. The steel plate fans will be five in number, varying from 7½ ft. to 4 ft. The Buffalo Forge Company also secured the contract for these outfits, which will be driven by Crocker-Wheeler motors.

G. M. GEST, the expert subway contractor, of New York and Cincinnati, has been awarded the contract for the construction of a heavy 40-duct conduit system by the Public Service Corporation of New Jersey. This system will run into thousands of dollars in cost and is a main trunk feeder line running through Hoboken and Jersey City. Work is to be begun on the 15th of March and a large force of men is to be employed to push the work rapidly. Mr. Gest has also closed with the B. M. & J. F. Shanley Co., of Jersey City, a contract for laying its conduits in Harrison, N. J., and Kearney, N. J.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Northern Illinois Lighting & Traction Company at Ottawa, Ill., for the installation of a battery of "Chloride" accumulators having a capacity of 160 kw-hours. This battery is to be used for current regulation. Contracts have also been closed for residential lighting and power plants for H. B. King, Prides Crossing, Mass., and Dr. C. E. Parker, Princeton, Mass., and with Frederick L. Milliken at Milton, Mass., for an isolated lighting plant.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., successor to the Christensen Engineering Company, manufacturer of air brake and electrical machinery, has just moved its executive offices and engineering department to its new building located at the works. The building is constructed of cement blocks 2 ft. long by 1 ft. high and is 200 ft. long x 66½ ft. wide. Extensions and improvements are also being made in the company's shops to supply the necessary facilities for handling its constantly increasing business.

LIGHTING EQUIPMENT FOR MEXICAN SUGAR PLANT.—The Reeves Engine Company, of Trenton, N. J., New York offices, Singer Building, has taken an order for a vertical cross compound engine for direct connection to a Crocker-Wheeler generator to be installed for the purpose of lighting the Panuco Sugar Company's plant at Tampico, State of Vera Cruz, Mexico. A 400-hp Reeves vertical cross compound engine, for direct connection to a centrifugal pump, has been ordered for a large rice plant near Houston, Tex.

WESTINGHOUSE EQUIPMENT FOR BRITISH STEEL WORKS.—The British Westinghouse Electric & Manufacturing Company, Limited, has been awarded the contract for the electrification of the extensive steel works operated by the Carnforth Iron & Steel Company, Limited. The Carnforth plant is being remodeled on American lines, Julian Kennedy, Sahlin & Co., Limited, London, of which Julian Kennedy, the well-known American metallurgical expert is one of the principals, having undertaken the work.

EQUIPMENT FOR NEW JERSEY NEWSPAPER PLANT.—The printing plant of the *Freie Zeitung*, at Newark, N. J., is to be electrically operated throughout. In the meantime, an order has been given for a lighting equipment. MacKenzie, Quarrier & Ferguson, 114 Liberty Street, acting on behalf of the Harrisburg, Pa., Foundry and Machine Works, secured the order for the engine, which will be direct connected to a Westinghouse generator.

PHILLIPS' CANADIAN FACTORY.—The Eugene F. Phillips Electrical Works, Limited, Montreal, Canada, intend adding to their factory plant the coming season one building 275 by 60 ft., one story high, and another building 180 by 60, three stories. The plant will be erected in the town of St. Louis. Nothing has been decided on yet as regards power. Mr. Geo. H. Olney, 2d, is the resident secretary and treasurer.

MEXICAN MINES.—The American-Mexico Mining and Development Company, which owns large mining interests in the vicinity of Torreon, Mexico, is to install a $50,000 electric plant at its Velardena Camp, for the purpose of lighting and operating the mines. Dr. W. S. Phillips, of Chicago, Ill., is president of the company. Dr. A. T. Grove, also of Chicago, is secretary-treasurer.

ALBERGER CONDENSERS FOR TESTING.—The Alberger Condenser Company, White Building, Liberty Street, New York, has secured a contract for two large high vacuum condensing equipments with two-stage vacuum pumps for installation in the turbine testing rooms of the Westinghouse Machine Company. They will be utilized to test turbines varying from 4,000 kw to 5,500 kw capacity.

AMERICAN TELEPHONE ORDERS.—Among switchboard shipments recently reported by the American Electric Telephone Company, of Chicago, are the following: Kenton, Ohio, one 100-line express; Adrian, Mich., one 100-line express; Three Lakes, Wis., one 25-line express; Muscatine, Iowa, two 100-line express; Frankford, S. Dak., one 100-line express.

INTERBOROUGH PACKAGE EXPRESS.—The question of operation of a package express on Interborough lines has been receiving consideration from Interborough interests. The question of a contract with the United Express Company has not, however, been brought formally before directors of the Interborough Rapid Transit Company.

PLANT FOR MEXICAN PLANTATION.—The Mexican Tropical Planters' Company, which possesses a large property known as the Columbia plantation, located on the Coatzacoalcos River, Isthmus of Tehuantepec, is about to be in the market for a large electric lighting plant. Mr. Louis Kunz is the general manager.

CONTRACT FOR MONCLOVA.—The contract has been let for the lighting and power plant for the city of Monclova, State of Coahuila, Mexico. Victor M. Braschi & Bro., of Mexico City, will undertake the work. The plant will entail an expenditure of about $100,000 gold.

PLANT FOR CUBAN SAW MILLS.—The Mackay Engineering Company, Singer Building, Broadway and Liberty Street, New York, has taken a contract for a complete electric plant to be used for lighting and operating large saw mills at Santiago de Cuba.

APPARATUS WANTED.—The Weston West Virginia Electric Light, Power & Water Company is in the market for a 300-hp steam turbine direct-connected to two 100-kw direct-current generators, 125 volts. Mr. J. S. Mitchell should be addressed on the subject.

CHICAGO TELEPHONE COMPANY shows for February a gain of 1,724 Bell instruments, making the total of subscribers in the system 104,368.

THE WATERBURY BATTERY COMPANY, of Waterbury, Conn., have increased their capital stock from $10,000 to $50,000.

General News.

THE TELEPHONE.

HANFORD, CAL.—The Independent Telephone Company has been incorporated with a capital stock of $25,000 to build a line from Lemoore to Hanford, a distance of ten miles. The incorporators are: H. L. McCubbin, P. Carrasco, and J. Mills.

WASHINGTON, D. C.—In the District appropriation bill which is now before the House, there is a paragraph relating to telephone service in the District. An amendment thereto has been offered by Mr. Bartlett, providing that none of the money appropriated shall be paid except at the following rates: $50 per annum for the use of a telephone on a single wire; $40 for each telephone where there are two in a wire; $30 where there are three; and $25 each where there are four or more on the same wire.

SEYMOUR, IND.—The Seymour Home Telephone Company is installing a 500-line board of the new lamp signal type manufactured by the Sterling Electric Company, of Lafayette, Ind.

SELMA, IND.—The Selma Co-operative Telephone Company has decided to purchase property for a new exchange. It will install a new switchboard and otherwise improve its plant and service.

MONROE CITY, IND.—The Wabash Home Telephone Company, operating an exchange and system in this city, has increased its capital stock $25,000. The corporation will make extensive improvements in the exchange and extend its lines during the present year.

ETHEL, IND.—The Morning Star Telephone Company has incorporated for the purpose of installing an exchange and telephone system in this city, Crawford and adjoining counties. The capital stock is $5000. The incorporators are: Joseph R. Allen, of Ethel; W. H. Williams and William J. Truly, of Traswell.

WARREN, IND.—The Warren Telephone Company's plant has been sold to George Griffith and Frank Canaday, who will organize a new company. The plant has been in operation for five years and includes a number of country lines. The new management will take charge April 1, when a general system of improvement will be begun.

SALAMONIA, IND.—The Salamonia Telephone Company has filed articles of incorporation with the Secretary of State. The company proposes to install an exchange and erect and operate telephone lines in this city and throughout Jay County. The capital stock is $5200. H. E. Barting, J. J. Kidder, John W. Crull and others are the incorporators.

NEW PALESTINE, IND.—The New Palestine Telephone Company, which operates a telephone system in the southern part of Hancock County, has planned to extend its lines into the northern part of Shelby County. A new metallic circuit will be put in, also a new switchboard in the exchange. The company has increased its charges from $1.20 to $2.

TERRE HAUTE, IND.—An important meeting was held in this city on March 2 by the representatives of independent telephone exchanges in eastern Illinois and western Indiana, representing a total of 14,000 telephones. The purpose of the meeting was to arrange a uniform long distance rate. Plans were made and a secretary employed to give his entire time to the unifying ot distance and applying the schedule of rates thereto.

SCHLESWIG, IA.—The Schleswig Telephone Company will build 30 miles of new line.

CAMBRIDGE, IA.—The Cambridge Independent Telephone Company will extend its system during the coming season.

VAN WERT, IA.—The Van Wert Rural Telephone Company has elected officers as follows: President, F. L. Hall; vice-president, J. F. Hockler; secretary, H. O. Tuttle; treasurer, F. O. Stearns.

LAKE CHARLES, LA.—Application has been made to the City Council by W. C. Easterling and W. C. Pfeiffer, representing Pennsylvania capitalists, for a franchise for installing a telephone system here.

GRAND HAVEN, MICH.—The Michigan Telephone Company is extending its lines from this city into the townships of Grand Haven, Robinson and Olive, and will expend several thousand dollars in extension work.

DETROIT, MICH.—The receiver of the Michigan Telephone Company will, about March 15, turn over the property of the concern to President W. A. Jackson, of the Michigan State Telephone Company, its successor.

NEW YORK MILLS, MINN.—A telephone company is being organized in this place.

GRANITE FALLS, MINN.—A farmers' telephone company has been organized at Stony Run.

TORDENSKJOLD, MINN.—A farmers' telephone company is projected here. Mr. E. E. Olson is interested.

VERNON, MINN.—The Farmers' Interurban Telephone Company has been incorporated with a capital stock of $50,000. The directors are B. C. Roe, A. S. Berge and others.

MONTROSE, MINN.—The Montrose Farmers' Telephone Company, of Montrose, Wright County, has been incorporated with a capital stock of $10,000, the incorporators being: C. A. Stolyman, A. C. Strey, E. W. Swanson, F. E. Belden, C. P. Stapleton, J. P. Thornquist, Louis F. Miller, F. G. Miller and C. F. Denvon, Montrose.

HARRISONVILLE, MO.—The Cass County Telephone Company has been incorporated with a capital stock of $50,000. The directors are R. W. and D. Adams.

ST. LOUIS, MO.—The Bell Telephone Company announces that beginning March 1, in the unlimited residence service, the direct line which has been $72 a year was reduced to $60, and the duplex line (two telephones on one line) was reduced from $48 to $42 a year. The charges for these services were at one time $80 and $60 a year. No other rates are changed. The Kinloch Telephone Company has recently made a $36 rate for its unlimited service, two-party residence telephones. Its one-party line, unlimited service rate remains $48. The Kinloch Company is rapidly extending its long-distance service and expects to connect with the system of the United States Telephone Company in Ohio before the opening of the World's Fair. Its lines are now within seventeen miles of the Ohio State line. When they reach Ohio and join those of the United States Telephone Company, they will be connected with 80,000 telephones east of Indiana. The company then will be able to reach Philadelphia and Buffalo and nearly all principal points in the interior of New York and Pennsylvania. In less than one month the lines will be connected with one of the telephone companies in Kansas City, and through its wires, with all important points in Kansas. These wires also reach St. Joseph and North Missouri. The line to Joplin is nearing completion. This line will give connections in Oklahoma, Indian Territory and Texas.

BARTLEY, NEB.—A new telephone company has been formed here.

KENESAW, NEB.—Mr. S. A. Westing is interested in a proposed telephone exchange in this place, which is to be organized with a capital stock of $10,000.

ALBANY, N. Y.—The Conesville & Gilboa Telephone Company, of New York, has been incorporated with a capital stock of $1000. The incorporators are: J. W. Gaylord, B. C. Wright and Elmer Baker.

TREADWELL, N. Y.—The Treadwell Telephone Company has been incorporated with a capital stock of $3000. The incorporators are: Robert Ballantine, Duane D. Wheat, of Treadwell, and U. R. Ogden, of Leonta.

NEW YORK, N. Y.—The New York Telephone Company will install a new exchange at 22 Cortlandt Street, to be called "Liberty." The new exchange will relieve the Cortlandt exchange of several hundred subscribers. Other down-town exchanges will also be relieved in a similar manner.

UTICA, N. Y.—At the recent annual meeting of the boards of directors of the Central New York Telephone & Telegraph Company and the Empire State Telephone Company, officers were elected as follows: For the Central New York Company—President, U. N. Bethell, New York City; vice-president; Joseph Rudd, Jr., Utica; secretary and treasurer, Francis G. Wood, Utica; chairman of the board of trustees, Charles F. Cutler, New York City. For the Empire State Company—President, U. N. Bethell; secretary and treasurer, Francis G. Wood; chairman of the board, Charles F. Cutler. No vice-president was elected.

COLUMBUS, N. C.—The Columbus Telephone Company is completing the installation of metallic circuits, thus affording long distance connections through the Bell Company with many outside points.

CHAGRIN FALLS, OHIO.—The exchange of the Chagrin Falls Telephone Company was destroyed by fire recently.

ADAMSVILLE, OHIO.—The Adamsville Telephone Company has been incorporated with a capital stock of $1000.

BRITTAIN, OHIO.—The Springfield Township Rural Telephone Company has been organized with a capital stock of $10,000. The incorporation papers are to be applied for at once.

COLUMBUS, OHIO.—The Waldo Home Telephone Company, of Waldo, has been incorporated with a capital stock of $25,000. The company will build systems in Marion, Union, Delaware and Morrow counties. The incorporators are: William Klingel, M. Lewis, A. Oborn, W. D. Kraemer and Sam Schwaderer.

TIFFIN, OHIO.—The Home Telephone Company, which recently increased its capital stock from $60,000 to $125,000, has changed its name to Tiffin Home Telephone Company. New officers have been elected as follows: President, F. B. Myers; vice-president, K. F. Briggs; treasurer, James J. Kintz; secretary and superintendent, Edwin R. Strohm.

SHIPPENSBURG, PA.—The subscribers of the United Telephone Company in this city are objecting to the discontinuance of free service to Carlisle and Wainsboro after April 1. The company proposes to charge tolls for conversations between the points named.

PORT BOLIVAR, TEX.—Messrs. Tuggle and Kitchen, of this place, are constructing a telephone line from here to High Island.

BELTON, TEX.—The Moody Telephone Company, of this place, has been granted a franchise to extend its lines through portions of the country.

SAN MARCOS, TEX.—The franchise of the Southwestern Telegraph & Telephone Company in this place has been declared forfeited by the City Council.

EL PASO, TEX.—Sam Byrne and S. Nicholls, of De Soto, Mo., are investigating the independent telephone situation here with the view of acquiring the uncompleted plant of the local system, which was started by Mrs. Brett. If the consent of the city authorities can be obtained, the system will probably be rehabilitated and completed.

CHRISTIANA, WIS.—The Christiana Farmers' Telephone Company has been incorporated, the directors being P. O. Nelson, S. Haight and others.

SILVER CITY, N. MEX.—It is announced that the Grant County Telephone Company, of this place, will build a long distance telephone line to the different mining camps situated in the Burro Mountains. This company now has an extensive telephone system, extending to all the leading mining camps and towns in the southwestern part of New Mexico.

TORONTO, ONT.—The Stark Telephone, Light & Power Company has applied to the city of Toronto for the privileges of establishing a telephone, light and power service within the city limits, and to obtain the right to lay down conduits, wires and cables, and where necessary to erect poles and string wires. The company promises to give a telephone service at $6 per year, and one cent per outgoing call for telephones in private houses, with a limit of $15 per annum. The rate for business telephones is to be $6 per annum and one cent per call, with a limit of $35 per annum. The company also promises reduced rates for light and power. It has already secured over 4000 telephone subscribers, and will proceed at once to install its system.

ELECTRIC LIGHT AND POWER.

SAN DIEGO, CAL.—The City Council has granted Charles E. Sumner, of Cleveland, O., an electric light and gas franchise. Mr. Sumner is supposed to be backed by H. E. Huntington, of Los Angeles.

RIVERSIDE, CAL.—The City Trustees are considering a proposition to establish a municipal electric light plant. The Tracy Engineering Company, San Francisco, has submitted a definite proposition to the trustees.

EUREKA, CAL.—The Eureka Lighting Company, it is stated, will at once begin the development of its water power on Trinity River, for the purpose of generating electric power. The plans contemplate the expenditure of nearly $500,000.

WHEATLAND, CAL.—The power line which the Bay Counties Power Company is building from the power house at Nimshew is nearly completed and will reach Colgate in the near future. The necessary equipment for the proposed extension has already arrived.

SAN FRANCISCO, CAL.—An additional generating equipment of 400-kw., in two units, will be installed in the isolated electric plant in the basement of the Rialto Building. The 500-hp boiler plant will be supplied through the California Engineering and Construction Company, the contract calling for three Franklin boilers of the Heine water-tube type. A new seven-story hotel to be erected on Market Street, adjoining the Palace, will be supplied with electric light and power from this plant, as well as the Rialto Building annex.

SAN FRANCISCO, CAL.—The Big Creek Power Company, of Santa Cruz, Cal., C. E. Lilly manager, has closed a contract for an additional Westinghouse alternating-current generator of moderate capacity. The Power Company contemplates the erection of an additional generating station at Chittenden from which it can supply light and power to Watsonville, Gilroy and Hollister. If satisfactory terms can be obtained for fuel, a large steam plant will be installed and fuel oil will be piped in from the Watsonville Oil Company's wells. The present plant is operated by water power and is inadequate to supply the demand.

SAN FRANCISCO, CAL.—The Watsonville Light & Power Company, which has been incorporated by C. W. Waller, A. W. Linforth, F. M. Ray, J. C. Love and J. H. Foote, with a capital stock of $250,000, is controlled by John Martin and other representatives of the California Gas & Electric Corporation. The latter company, which owns numerous lighting plants in Northern California, has only one as far south as Fresno, but the new acquisition may result in extending the system southward along the coast. The Watsonville Light & Power Company will absorb in Watsonville two gas companies and the Watsonville Electric Light Company's steam plant, installed by F. M. Smith.

COLORADO SPRINGS, COL.—The Colorado Electric Power Company is made the defendant in a foreclosure suit brought by the Union Trust Company, of Pittsburg, as trustee. The suit is to recover $2000 and interest, which with other claims brings the total up to $226,700.

WASHINGTON, D. C.—Bids will be received March 22 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of steel-plate fans, blowers, electric motors, arc lamps, rubber and lead-covered wire and cable, conduit and fittings, electrical supplies, iron pipe, pipe fittings, valves, etc.; also April 5 at the Navy Yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of electric blowers, motor generator set, conduit and fittings, electrical supplies, iron wire, galvanized sheet steel, wrought iron pipe, rivets and asbestos cement, Portland cement, etc. H. T. B. Harris, Paymaster-General, U. S. N.

COVINGTON, GA.—C. C. Brooks, of Covington, writes that it is proposed to develop the water power of Alcova River at a cost of $100,000. The company is not yet organized.

BLUE RIDGE, GA.—E. B. Garwood, manager Blue Ridge Electric Light & Power Company, writes that it is proposed to construct a larger plant for lighting and power, to be operated by water.

BELLEVILLE, ILL.—A mortgage for $350,000, to cover an issue of bonds to that amount, was filed in the St. Clair County Recorder's office in this city, March 1, by the East St. Louis Trust & Savings Bank, trustees for the Muskogee Electric & Gas Company of Indian Territory. The East St. Louis Trust & Savings Bank probably will float the bonds.

ALTON, ILL.—A movement is on foot in North and Upper Alton to secure a joint lighting plant of their own, and thus be independent of the Alton Light & Traction Company, which is now furnishing current to both towns at what is considered an exorbitant price. The idea is to locate the power house midway between the two towns, which are only a few miles apart, and to secure a plant sufficiently large to fill the needs of both places. The town of Grafton has just made a lighting contract for ten years whereby the village secures an all-night service every night in the year for about $30 per light.

MONTICELLO, IND.—The Tippecanoe Power Company has purchased from Bradner & Smith what is known as the Tioga Paper Mill site at Tippecanoe Falls, near Monticello, Ind. The 100 acres adjacent to the falls is being cleared of timber to make locations for factories. The plan of the company is to develop 5000 horse-power from the falls. Two dams will be built. Theophilus King, banker, Boston, Mass., is at the head of the company.

LONDON, KY.—The London Electric Light Company has been chartered, with R. M. Jackson president.

BALTIMORE, MD.—A bill has been introduced in the House at Annapolis providing for the municipal ownership of an electric lighting plant in this city. The question whether the plant shall be established, and the debt therefor contracted, will be submitted to the voters at the general election in 1905.

BROWNING, MO.—Carl Thudium, of Brookfield, is interested in the construction of an electric light plant.

ST. JAMES, MO.—Chas. W. Orendorf and J. W. Scott, of St. Louis, have secured a franchise from the City Council for an electric light plant, also right of way through the town and depot facilities for an electric road to be constructed from Jefferson City to a point on the Mississippi River opposite Chester, Ill.

COLUMBIA, MO.—The citizens have voted to issue $100,000 bonds for the purchase by the city of the water works and electric light plants owned by the Columbia Water & Light Company. The plant will be purchased for $67,000, will be improved and a system of deep wells installed.

ST. LOUIS, MO.—A municipal plant for lighting that portion of the city south of Keokuk Street is being planned by the city officials. The introduction of an ordinance providing for the plant hinges upon the amount of money demanded by the police board. Should the amount required for the police not be excessive, it is thought that the city can afford the $140,000 which will be needed to erect an electric lighting plant. The location of the plant has already been selected. It is intended to place it on the river front, between Elwood and Kraus streets. The territory whch it is intended to light is now divided between the Carondolet Gas Company and the Welsbach Lighting Company. The first company receives $54,000 annually and the latter $5000.

WEBSTER, N. H.—Horace J. Davis, of Contoocook, general manager of the Blackwater Power Company, writes that it is proposed to develop the power of Blackwater River at Webster.

WEEHAWKEN, N. J.—The Committee on Lighting has been directed to have plans prepared for an electric light plant for the township, to be installed in the new pumping station at a cost of about $5000.

NIAGARA FALLS, N. Y.—It is stated that the Toronto & Niagara Falls Power Company has decided to use steel towers for its transmission line between Niagara Falls, Ont., and Toronto. The towers will be 8 or 10 feet square at the base and about 50 feet high, and will be placed at intervals of 400 feet.

NEWBURGH, N. Y.—Mr. T. E. Hayes, of Middletown, has been appointed receiver for the Neversink Light & Power Company, which has a plant at Rose's Point, near Cuddebackville. The appointment of a receiver is the result of the action brought by Mr. Hayes to recover on a promissory note upon which judgment was taken and sequestration proceedings instituted. The Neversink Light & Power Company began business about a year ago and has furnished power to Port Jervis for street lighting, also for the electric railway operated by the Port Jervis Gas, Electric Light & Power Company.

FAYETTEVILLE, N. C.—The Cape Fear Electric Power Company is laying the foundations for a sub-station in Fayetteville for the transmission of power from the river to the town, to be utilized in mills and other industries.

ASHEVILLE, N. C.—The Biltmore estate, near Asheville, has been furnished power for the first time over the transmission lines of the W. T. Weaver Power Company's plant. The power, however, does not come from this company's plant, which will not be ready to furnish the same until April 1, when the Biltmore estate will take 250 horse-power and the Asheville Electric Company will take 600 horse-power.

GLACE BAY, N. S.—Glace Bay about two years ago installed an electric light system which is owned and operated by the town. The people have been given a good electric service, cheap light, and on the operation last year the town cleared the sum of $1,800 over and above operating expenses.

BRIDGEWATER, N. S.—The town of Bridgewater earned last year, through its electric light plant, which is municipally owned and operated, over $1,700 above expenses, and the saving thus enabled the town to have its streets lighted, water for fire protection and good sewerage without cost to the town.

CLEVELAND, OHIO.—The contract of the city with the Cleveland Electric Illuminating Company fixes a price of $75 per arc per year.

BELLEFONTAINE, OHIO.—The Board of Public Service has received plans for the municipal electric light plant, which, it is estimated, will cost $10,000.

YORK, PA.—The floods during the first week of the month caused damage to the power plant at York Haven to the extent of about $5000.

CHAMBERSBURG, PA.—The Shippensburg Electric Light, Heat & Power Company has been amalgamated with the Shippensburg Gas & Electric Compand. The new combination has a capital of $45,000.

YORK, PA.—The directors of the recently chartered Deer Creek Water & Power Company have effected an organization by the election of the following named officers: President, James H. Gable, of York; vice-president, J. Benson Gable; secretary, J. N. Wilson; treasurer, Charles F. Ramsey; superintendent of construction, J. K. Green, of York. The company proposes to construct a dam and power plant on Deer Creek, one mile from Stewartstown, for the purpose of furnishing water power and electric light to Stewartstown and vicinity.

SHERBROOKE, QUE.—The City Council has accepted the offer of the Heat, Light & Power Company for its plant, for $233,000, but before the contract is made with the company the question will be submitted to the property holders for their approval.

CARTHAGE, TENN.—Dr. Drake is interested in the construction of an electric light plant.

FARMERSVILLE, TEX.—The Farmersville Mill & Light Company has been organized, with a capital of $50,000. H. L. Carver and E. W. Stewart are interested.

TOOELE, UTAH.—The Clark Electric Company, of Tooele, is considering the installation of an electric light plant near Richfield.

EMPORIA, VA.—The Greenesville Water Power Company has been incorporated at Emporia, Va., with a capital of $10,000 to $50,000. W. Samuel Goodwyn is president of the concern.

BELLINGHAM, WASH.—The Likens-Wyatt Power Company has been granted a franchise to establish and operate a power plant in this city.

WAUPACA, WIS.—The Waupaca Electric Light & Power Company has increased its capital stock from $75,000 to $125,000.

OMRO, WIS.—The Omro Electric Light Company has been incorporated with a capital of $10,000.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The directors of the Birmingham Railway, Light & Power Company have issued a call for a meeting of the stock-holders, to consider the proposition of negotiating a loan of $1,000,000 for improving the system. The company proposes to double the capacity of the electric power plant and the gas plant, and to make extensions and improvements on its street railway system.

STONINGTON, CONN.—The contract for the building of the Groton & Stonington Street Railway has been awarded to the John B. Macafee Company, of Philadelphia. The contract includes the power station complete.

HARTFORD, CONN.—The Hartford Street Railway Company has applied to the municipal authorities for approval of its plans to extend its lines within the city limits. The company has also under contemplation the extension of its suburban lines.

BRIDGEPORT, CONN.—The Connecticut Railway & Lighting Company is enlarging its power station for the Bridgeport division of its system. The plant has been extended and an 800-kw generator, directly connected with a 1200-hp engine, is now being installed. It will be at least two months before the new generator will be ready for use. The plant will then have a capacity of 3600 horse-power, and will supply power, not only for the local lines, but for the Milford and Westport branches.

MATTOON, ILL.—The promoters of the Mattoon-Charleston Electric Railway will in all probability construct a line between this city and Champaign, as a continuation of the former line.

ROCK ISLAND, ILL.—The Tri-City Railway Company is perfecting plans for concentrating all its power generating plant into one large station on the site of the present plant in First Avenue, Rock Island, from which it will be able to furnish current for the operation of all its lines in the three cities. At the present time the Rock Island plant only furnishes sufficient power for the operation of the cars on the Illinois side of the river, and it has been found necessary to obtain power from the People's Power Company for the operation of the lines in Davenport. The improvements will involve a large investment of capital.

WARSAW, IND.—The City Council has granted a franchise to the Goshen, Warsaw & Winona Electric Railway. Cleveland capitalists, headed by J. B. Hanna, are behind the project, and there is no doubt about the immediate building of the road.

WABASH, IND.—The contract for all the material to be used in the completion of the Wabash & Rochester Electric Railway has been awarded to a New York firm. The contract includes rails and overhead work, power house machinery and cars. The work of grading for the road began March 1.

FT. WAYNE, IND.—The Ft. Wayne, Logansport, Lafayette & Lima Traction Company has filed amended articles of association with the Secretary of State, changing its name to the Ft. Wayne & Wabash Valley Traction Company. The articles also provide for the extension of the system to Goshen, Elkhart, Mishawaka, South Bend, Ligonier and other places. The directors of the newly-formed company are: H. C. Paul, J. L. Jones, Randall Morgan, Bayard Henry, S. B. Fleming, James Murdock and G. F. McCulloch.

DUBUQUE, IA.—At the recent annual meeting of the stockholders of the Union Electric Company, held in this city, a plan of procedure was mapped out for the improvements which are to be made to the property. All the tracks, both inside and outside the city limits, will be relaid and the roadbed placed in first-class condition, and a new power house will be built and improvements made in Nutwood Park. The new power house will be of such capacity and facilities that ample power will be furnished for the operation of the street railway system and the electric light plant, and the entire system will be as modern as it is possible to make it.

WORCESTER, MASS.—Claims against the Worcester & Southbridge Street Railway Company were filed recently with Charles M. Thayer, one of the receivers. A greater portion of the claims will be settled on a 50 per cent. basis through a syndicate, which plans to operate the road. Several persons, however, have refused to settle on that basis.

MIDDLEBORO, MASS.—John T. Burnett, of Southboro, and John L. Hall, of Boston, have been appointed receivers of the Middleboro, Wareham & Buzzard's Bay Street Railway Company. The appointment was the result of a suit brought by the American Electrical Works, one of the company's creditors. The receivers have been authorized to operate the road.

OWOSSO, MICH.—The Owosso & Corunna Traction Company has sold its line to a Pennsylvania syndicate that controls a number of lines around Allentown, Pa., and also has control of the public lighting franchise in the city of Flint. The new company has secured an extension of franchise rights in Owosso and Corunna, and will also extend the road to Durand.

BENTON HARBOR, MICH.—The Kalamazoo & Lake Michigan Railroad Company will have 66 miles of interurban road, from Kalamazoo to Benton Harbor, Mich., constructed this year by the Western Engineering & Construction Company, Chicago. G. A. Mullins is general manager, and Eric Wolff is chief engineer and general superintendent. Contracts are now being let. The road will have five sub-stations. Two direct-connected 1000-kw units will be installed in the power house.

KANSAS CITY, MO.—The Fifteenth Street line of the Metropolitan Street Railway Company is to be extended to Centropolis.

RENO, NEV.—It is officially stated that the new electric railway between Reno and East Reno is an assured fact, and that work is to begin immediately. J. B. O'Sullivan, president, states that the material for constructing the line has been shipped.

RALEIGH, N. C.—The Raleigh Electric Street Railway is considering a proposition to build a 28-mile line to Durham.

JAMAICA, N. Y.—The New York & Long Island Traction Company has filed in the Queens County Clerk's office its franchise granted by the Board of Aldermen, permitting it to lay about 25 miles of track in the town of Jamaica over three routes extending in an easterly and westerly direction.

NEW YORK, N. Y.—William G. McAdoo, president of the New York & New Jersey Railroad Company, which is building the tunnel recently completed, from Jersey City to New York, has sent to the Rapid Transit Commission an application for permission to extend the New York spur of that tunnel up to Sixth Avenue and Thirty-third Street. According to the plan he proposes, the tunnel will continue from West Tenth and Greenwich Streets, where its terminal originally was projected, in a northeasterly direction under West Tenth Street to Sixth Avenue, and then straight up the avenue to Herald Square.

NIAGARA FALLS, N. Y.—The International Railway Company's new power house in North Tonawanda has been completed and is now in operation. The power plant supplies energy for the Buffalo & Niagara Falls line from La Salle to the Buffalo city line; the Buffalo & Lockport Railway from the Buffalo city line to Lockport, and the Buffalo & Kenmore line from the Buffalo city line to Gratwick. The equipment is of the General Electric Company, and consists of three 350-kw rotaries. There is also a 1200-ampere-hour battery which was installed by the Electric Storage Battery Company. The International Company's new power house in Lockport is also in operation. This plant takes care of the Lockport-Olcott line; the local street railway and the Gulf branch. It also supplies power for the Buffalo-Lockport line from Lockport to North Tonawanda. In this plant are installed two 350-kw rotaries and an 1800-ampere-hour battery.

NEW YORK, N. Y.—Borough President Littleton, of Brooklyn, made public his plans for the proposed municipal elevated railroad to connect the terminals of the Brooklyn and Williamsburg bridges on both sides of the river. The suggested road is to be built, owned, and operated by the city. Mr. Littleton's plan provides for the construction of an elevated road through Centre and Delancey Streets, in Manhattan, connecting the termini of the two bridges, with stations at the terminal of the Brooklyn Bridge, Centre and Worth Streets, Centre and Howard Streets, Delancey Street and the Bowery, Delancey and Allen Streets, and the terminal of the Williamsburg Bridge. The proposed railway would cross the Williamsburg Bridge to South Fifth Street, Williamsburg, up this street to Union Avenue, and to Broadway to Throop Avenue to Willoughby Avenue, through Fort Greene Park by a tunnel under the hill to Willoughby Street, to Fulton, to Washington, to the Brooklyn terminal of the Brooklyn Bridge. The proposed road would be partly a four-track and partly a two-track structure, and there would be eight stations on the line in Brooklyn. Mr. Littleton and Commissioner of Public Works John C. Brackenridge estimate that the proposed railroad would cost about $10,000,000. They figure that with a three-cent fare it would pay 3½ per cent. on the bonds and leave a net profit of nearly a quarter of a million dollars each year.

MONESSEN, PA.—The Webster, Monessen, Belle Vernon & Fayette City Street Railway will extend its line to Fayette City.

HARRISBURG, PA.—A charter has been granted at the State Department to the Wayne Electric Street Railway Company, capital $6000, to build a one-mile line at Wayne.

CHAMBERSBURG, PA.—The Chambersburg & Gettysburg Electric Railway Company has secured an option on a property in this town which is to be used as a site for a power house.

ELWOOD CITY, PA.—A franchise has been granted to the Elwood City Electric Street Railway Company. This railway will connect with the Newcastle and Beaver Falls lines at Whitedale, three miles west of this place.

LANCASTER, PA.—A charter has been granted to the Strasburg & Georgetown Street Passenger Railway Company, capital $6000, to build a one-mile line from Strasburg turnpike along the Georgetown public road. This is to be part of the system to connect this city and Philadelphia. Albert H. Swing, of Coatesville, is president.

WEST CHESTER, PA.—It is reported that a plan is being considered for the merging of the interests of the West Chester Street Railway Company with those of Wilmington capitalists who have franchises in that city, and to the Delaware line, the combined company to construct and operate an electric railway between Wilmington and Lenape.

LANCASTER, PA.—A conference has been held between representatives of the Lancaster & Quarryville Trolley Company and the Conestoga Traction Company regarding a connection with the Strasburg line at Elliott's Corner. The new line will follow the Big Spring and Beaver Valley pike from Repton to Elliott's Mill. The route is now being surveyed.

MONTREAL, QUE.—Dr. Payette, of this place; J. E. E. Dickson, of Westmount, and H. Fontier, of Montreal, are applying for a charter to build an electric railways through the counties of Hochelaga, Jacques Cartier, Laval, Two Mountains, Argentine and Terrebonne.

PROVIDENCE, R. I.—An act to incorporate the Worcester & Providence Street Railway Company was introduced in the House of Representatives and referred to the Committee on Corporations. The act authorizes the issuing of $1,000,000 of capital stock and the issue of bonds for a like amount; also authorizes the company to acquire land by condemnation and to lease and buy other railroads.

OGDEN, UTAH.—The Ogden Rapid Transit Company has been granted a franchise to operate a street railway system through some of the most important streets of the city.

NORFOLK, VA.—Mr. R. I. Mason, receiver for the Hampton Roads Electric Railway, will, it is reported, apply for permission to issue $150,000 of receiver's certificates to complete the road.

WALLA WALLA, WASH.—James Galloway has asked the City Council for a franchise for an electric street railway, claiming that he represents eastern parties in the enterprise. The Council has previously been troubled with unreliable promoters and has required that Galloway make a deposit of $2000 as evidence of good faith.

MANITOWOC, WIS.—The Fond du Lac & Northeastern Electric Railway Company has made application for a franchise to enter this city.

NEW INDUSTRIAL COMPANIES.

THE RICE & BALDWIN ELECTRIC COMPANY, of Hartford, Conn., has increased its capital stock from $10,000 to $20,000.

THE TROY TELEGRAPH CONSTRUCTION COMPANY, New York, has been incorporated; capital, $10,000. Directors: Thomas L. Hughes, L. B. Grant and Ashley T. Cole, New York.

THE THIRD RAIL SAFETY SIGNAL COMPANY, New York, has been incorporated; capital, $25,000. Directors: G. F. Balentine and A. P. Nevin, New York, and Otto Ernst, Larchmont.

THE ADAMS INCANDESCENT LIGHT COMPANY, New York, has been incorporated; capital, $200,000. Directors: Thomas Adams, Jr., Bay Shore; L. R. Adams, New York, and G. J. Adams, Brooklyn.

THE RITER-CONLEY MANUFACTURING COMPANY, Pittsburg, has secured the contract for the building of a large steel stack for the power house of the Manila Electric Railroad & Lighting Corporation, Manila, P. I.

THE ACKERMAN-BOLAND TELEPHONE COMPANY has been incorporated in Chicago with a capital stock of $6000, to manufacture electrical apparatus. The incorporators are Charles Ackerman, J. F. Boland and J. W. Liggett.

THE VORTEX ELECTRICAL FAN COMPANY has been formed at Augusta, Me., to manufacture electrical devices. Its capital stock is $225,000, of which $50 has been paid in. Mr. Howard F. Butler, of Boston, Mass., is president and treasurer.

THE DITTRICK & JORDAN ELECTRIC COMPANY, Cleveland, Ohio, has been incorporated with $12,000 capital stock, by A. R. Dittrick, J. Jordan, W. E. Davis, F. A. Little and A. D. Dittrick. They will do electric railway repair work.

THE COOLEY ELECTRIC PROCESS COMPANY has been incorporated at Augusta, Me., to manufacture electrical machinery and appliances. The capital stock is $50,000. The officers of the company are: President, John F. Cooley, Boston, Mass.; treasurer, Robert Cushing, Brookline, Mass.

THE SHEDD ELECTRIC COMPANY, of Elizabeth, N. J., has filed articles of incorporation, the capital stock being $250,000. The company will conduct a general electrical supply business. The incorporators are: W. H. Peck, J. F. Symes, C. A. Matthews, H. C. Henshaw and H. R. Palmer, all of New York City.

OBITUARY.

MR. JOHN B. O'HARA, associate editor of the *Street Railway Journal*, died at the residence of his brother-in-law, J. G. Hickey, in Rochester, March 13. Mr. O'Hara joined the editorial department of the paper just two years ago. He was born in Rochester on December 10, 1865. After graduating from the public schools he became connected with the *Rochester Herald* and was afterwards appointed associate city editor of the *Post-Express*. Fifteen years ago he went to Chicago to join the editorial staff of the *Western Electrician* and became editor in chief of that paper. This position he occupied for a number of years with marked success. Later he was offered a proprietary interest and business management, with editorial control, of *Modern Machinery*, a monthly paper published in Chicago. He was soon obliged to resign this position on account of failing health, and to take a long vacation. Partially recovering and being of a disposition which would never permit unnecessary idleness, Mr. O'Hara joined the Publication Department of the Westinghouse Companies with headquarters in New York, but after a few months' connection with this company was offered and accepted the position on the editorial staff of the *Street Railway Journal*. Ten years ago Mr. O'Hara was married to Miss Margaret Hickey. After her recent death he attended the body to Rochester where the interment took place, but serious illness followed so soon in his own case that he was unable to attend the funeral in that city. His death occurred just four weeks after that of his wife, and was caused by valvular heart trouble. He is survived by an only son aged eight years, his father and two sisters. Mr. O'Hara possessed the high esteem and respect of all with whom he was acquainted, and especially of his immediate associates who had an exceptional opportunity of learning and appreciating his high character and admirable qualities of mind and heart. He was an associate member of the American Institute of Electrical Engineers.

LEGAL.

JEFFERSON CITY, MO.—The Supreme Court in banc has decided that the charter of Kansas City did not give the city authority to pass an ordinance regulating telephone charges in that city. J. W. Garner, of Kansas City, instituted mandamus proceedings in the Supreme Court against the Missouri & Kansas Telephone Company to compel the company to reduce its rates to the scale fixed by the city ordiance. The writ is denied by the Supreme Court.

VALIDITY OF FRANCHISE.—The Supreme Court of Louisiana has held that the franchise granted in New Orleans to the Consumers' Electric Company is valid. Its syllabus of decision says: "City Ordinance No. 1694, granting to the Consumers' Electric Company the privilege of using the streets and public places for laying of conduits, etc., falls within the scope of section 86 of the city charter as amended, and said ordinance, having been passed in accordance with the requirements of said section, is valid. The furnishing of electric light and energy to private consumers is not a public duty or function, or a utility to become public on terms, within the meaning of section 87 of the city charter as amended."

PERSONAL.

B. H. WARREN.

MR. B. H. WARREN.—The recent election of Mr. B. H. Warren to the presidency of the Allis-Chalmers Company, as noted in our columns last week, renders very timely the publication of a portrait and some biographical data about this well-known engineer and man of affairs. Mr. Warren graduated in the engineer corps at the United States Naval Academy in 1874, and was in active service in the United States Navy at sea and on shore until 1878, when he resigned from the service to find larger opportunities for his energies. From 1878 until 1890 he was with the Hancock Inspirator Company, Boston, Mass., as mechanical engineer, manager of the London office four years and as superintendent six years. From 1890 to 1895 Mr. Warren was manager of the hoisting machinery and pulley block department at the Yale & Towne Manufacturing Company, Stamford, Conn. He went thence, when the business of that department was sold, to the Pratt & Whitney Company, Hartford, Conn., serving temporarily as assistant secretary and treasurer. Mr. Warren was next, from 1896 to 1902, with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., as assistant general manager, in charge of manufacturing, for ten months, then as second vice-president, in charge of both the manufacturing and the commercial branches of the business. This is a remarkably wide experience, and a most felicitous preparation also for the duties incumbent upon the president of such a concern as the Allis Chalmers, making apparatus for all the four powers—steam, gas, water and electricity. Mr. Warren assumes his new responsibilities this week, and thus will have a very active part in the successive developments which are raising the Allis-Chalmers Company into an industrial organization of the first magnitude, his marked improvements in methods of manufacture, in works management, in broad plans for increasing output and decreasing expenses, as well as multiplying efficiency, all now having a wider platform for their display than ever before. Mr. Warren, by the way, is a Bostonian. He has also a lovely country-place in Virginia. He is a member and an ex-vice-president of the American Society of Mechanical Engineers; a member of the Society of Naval Architects and Marine Engineers; and a member of the Society of Naval Engineers. He is a member of the University Club, of New York, and of the Engineers' Club. After he has completed his inspection of the Allis-Chalmers Company's works at Scranton, Cincinnati, Chicago and Milwaukee, his offices will be established in the Empire Building, 71 Broadway, New York. It is two years since Mr. Warren severed his Westinghouse connections.

MR. W. STANLEY, JR.—It is understood that Mr. Stanley will not carry out plans recently announced of acting as consulting electrical engineer to the Allis-Chalmers Company, but will confine himself, at least for the present, to experimental work.

MR. ASA M. MATTICE has resigned as chief engineer of the Westinghouse Machine Company and consulting engineer of the Westinghouse Electric & Manufacturing Company, to accept the position of chief engineer of the Allis-Chalmers Company.

MR. H. B. KIRKLAND.—The many friends of Mr. H. B. Kirkland, general sales manager of the American Circular Loom Company, will be pleased to know that he has almost fully recovered from his recent severe illness and is in receipt of many congratulations.

MR. JOHN F. KELLY, of the John F. Kelly Engineering Company, has resigned from the position recently assumed by him as chief electrical engineer of the Allis-Chalmers Company, finding that the responsibility and work involved from his connection with both concerns was more than he could well carry.

MR. CARLOS G. PALACIOS, the chief engineer of the electrical end of the Caracas Gas & Electric Light Company, who has been here for the past month on behalf of his company and also for the La Guayra Electric Light Company, will sail March 19 for Venezuela. Mr. Palacios was the first introducer of American electrical machinery into Venezuela. While in New York he placed through the export commission house of Kates & Bok some $75,000 of orders for various equipment, details of which were noted in our issue of February 13. Mr. Palacios expects to cause the sending here of a number of requisitions, shortly after his return home, for machinery to be installed in various Venezuelan plants owned by capitalists for whom he acts in an advisory capacity.

MR. OSCAR T. CROSBY.—Owing to a prolonged absence in Europe, Dr. M. I. Pupin has not arrived early enough to deliver this month, as already announced, his lecture on the Physics of Wireless Telegraphy, before the New York Electrical Society. The officers of the society have, however, very great pleasure in informing the members that in response to an invitation addressed to him by a number of his friends, members of the society and of the American Institute of Electrical Engineers, Mr. Oscar T. Crosby, E. E., the distinguished engineer and explorer, has kindly consented to deliver a lecture entitled "Things Seen in Turkestan and Thibet," at the lecture room of the American Institute, 19 West 44th Street, Wednesday, March 23, at 8 P.M. Due notice will be issued. Mr. Crosby has returned recently from the mysterious mountain plateau of Central Asia, and his adventures constitute a most fascinating and instructive story. The lecture will be illustrated by some 30 lantern slides, and the officers of the society congratulate their fellow members on this delightful and unexpected supplement to the winter programme, already so notable for its successes. It is a ladies' night.

CARL SCHWARTZ.

MR. CARL SCHWARTZ has been appointed on the staff of the New York Central R. R. electrical engineering department as assistant engineer, and will be connected with the design and erection of the electrical part of the traction power stations. Mr. Schwartz after graduation from the Royal Technical College in Hanover, Germany, entered the Allegemeine Elektricitats Gesellschaft as designing engineer and later was appointed by the Siemens & Halske Company chief engineer of its light and power department in St. Petersburg, Russia, where he designed and erected a number of important low and high-tension power stations and power distributing systems. Mr. Schwartz was with Siemens & Halske for about seven years, and latterly was their general representative for the South of Russia and director of a concern for light and power utilization which he organized with a capital of 4,000,000 rubles, and which controlled stations of 6000 and 1500 horse-power, three-phase. Coming to the United States, Mr. Schwartz visited the works of all important manufacturing companies and the more prominent central stations in order to familiarize himself with the conditions in this country. Concluding to stay in the United States, he accepted a position with the Commonwealth Electric Company in Chicago, where he had charge of the design of the electrical part of the New Fisk Street Station laid out for 14 Curtis steam turbines of 5000 kw each, and into which he introduced a number of new features in high-tension power station design. He was also in charge of the erection of several new substations for 1000-kw rotary converter-units, and a high-tension distributing system of his own design.

MR. S. J. CONDIT, JR., of Boston, was a visitor in New York City last week, on important business.

W. E. BAKER & COMPANY, electrical and mechanical engineers, have moved their offices from 170 Broadway to 27 William Street, New York.

DR. LEE DE FOREST, of the American De Forest Wireless Telegraph Company, is to lecture before the Franklin Institute on March 31 on wireless telegraphy.

MR. F. P. FISH, president of the American Bell Telephone Company, recently arrived in San Francisco on a visit, and was entertained extensively by prominent citizens.

MR. E. A. WAKEMAN, formerly with the Batavia, N. Y., Consolidated Gas & Electric Company, has become superintendent of the Glens Falls, N. Y., Gas & Electric Company.

MR. ROBERT McCULLOCH, a veteran street railway manager, has returned to an old "stamping ground," having just been elected second vice-president of the St. Louis Transit system.

MR. G. E. BENNETT, formerly assistant manager of the Chicago office of the Nernst Lamp Company, has been appointed district sales manager of that company, with offices at 17 West Mohawk Street, Buffalo, N. Y.

MR. C. L. EDGAR, president of the National Electric Light Association, was at headquarters in New York City last week, busily engaged making preparations for the Boston convention next May. A large and interesting programme is already promised.

MR. CLARENCE J. MESSER, of the United Telpherage Company, of Boston, will deliver a lecture on telpherage or the modern electric art of transporting material aerially on a wire track, etc., before the Franklin Institute, Philadelphia, on April 14.

MR. JAMES I. AYER, general manager of the Simplex electric heating department, was a visitor to New York last week, and had a variety of most interesting data as to new heating problems and successful work, with which he has been dealing quite recently.

MR. CORNELIUS C. VERMEULE, consulting engineer, 203 Broadway, New York, has gone to Cuba in connection with the construction of the extensive lighting and traction system in and around Cienfuegos. He expects to be back by the end of the month.

MR. CHARLES RICOU, electrical engineer, etc., connected with the central station at Hanoi, Tonkin, French China, and consulting engineer of the Tramways Company, will be glad to receive catalogues of electrical apparatus bearing upon various applications.

MR. W. S. DORAN, at one time associated with the Worthington interests and who now is prominently identified with the sales department of the British Westinghouse Electric & Manufacturing Company, Limited, sailed for Europe March 1, after a short visit to this side.

MR. W. D. RAY has severed his connection with the Westinghouse Traction Brake Company as representative for the Central States, and has now entered the steam specialty field. He will represent several well-known manufacturers in the sale of high grade specialties, with offices at 312 Electric Building, Cleveland, O.

MR. HERBERT LAWS WEBB, of whom we published an illustrated biographical sketch in our issue of February 20, has taken offices in London as a telephone engineer, etc., at 35 Old Queen Street, Westminster. He will be glad to receive there catalogues from American manufacturers of telephone and telephonic appliances.

MR. JAMES STEWART, under whose supervision the colossal works at Trafford Park, near Manchester, of the British Westinghouse Electric & Manufacturing Company, Limited, were constructed and who latterly built in record time a number of large power houses for which the company secured the contracts, is to locate permanently in New York. He will open offices very shortly and will engage in general contracting work.

MR. C. O. MAILLOUX, of New York City, lectured before the engineering students of Delaware College, Newark, Del., Thursday and Friday, March 3 and 4. His general subject for all the talks was "Central Station Practice." This had been arranged by the Department of Mechanical and Electrical Engineering for the purpose of bringing the class room work more closely in touch with engineering practice. Mr. Mailloux has lectured before Lehigh, Cornell, Harvard and other universities, where the value of his suggestive talks to the students has been highly appreciated.

GEN. FRANCIS V. GREENE, general manager of the Ontario Power Company, spoke before the Niagara Club, at Niagara Falls, on March 4, on "The Future of the Niagara Frontier." He pointed out very forcibly that the improvement of the Erie Canal would mean a remarkable development of that section and the restoration of the Empire State to the supremacy in the industrial world He said that cheap power, generated at the Falls, cheap raw material and railroad and lake transportation, would bring about the establishment on the Niagara frontier of large industries in steel and iron electrochemical products, milling and various textile lines.

MR. J. G. WHITE, head of the engineering firm of J. G. White & Company, of New York, gave a dinner at the University Club last week to Secretary of War Taft, formerly governor of the Philippines. Mr. White is now building 40 miles of trolley road in Manila, and Mr. Taft is anxious also to interest American capital in steam railroad enterprises in the Islands. A distinguished party met Mr. Taft, including Mr. Elihu Root, late Secretary of War; and members of the leading banking houses of New York and the Eastern States. Mr. Oscar T. Crosby, who has recently returned from a journey through Thibet, was one of the speakers.

MR. EDWIN REYNOLDS.—Milwaukee newspapers state that Mr. Edwin Reynolds, consulting engineer of the Allis-Chalmers Company, was unanimously tendered the position of chief engineer of the committee of awards of the Louisiana Purchase Exposition at St. Louis. He declined the honor. His final decision was given to a special committee of machinery exhibitors who went to Milwaukee from St. Louis last week for the express purpose of urging him to accept the place, one of the most honorable and important positions connected with the exposition. In declining the honor, Mr. Reynolds informed the committee, as he had done before by letter, telegraph and telephone, that he did not feel that he could undertake the responsibility at this time, largely on account of his advancing years and the time it would require during the entire exposition. Out of a total of thirty-three votes by the largest machinery exhibitors in the world, who will have extensive exhibits at St. Louis, Mr. Reynolds received thirty votes on the first ballot for the position of chief engineer of the committee of awards. Later he received the unanimous vote of the exhibitors. A salary of $10,000 was voted to go with the position. Then the exhibitors started to induce him to accept. From the beginning he told the committee that he did not feel that he could undertake the work, because if he did he would not neglect it, and would only sign certificates after becoming personally convinced of the justice of the awards, and he did not now feel equal to the undertaking.

Trade Notes.

EXHAUST HEADS.—The Burt Manufacturing Company, Akron, Ohio, has sold the Jones & Laughlin Steel Company a 30-inch exhaust head for its plant at Pittsburg, Pa.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for Zenith lamps, is sending out a handsome descriptive catalogue of these lamps, to all who failed to receive one on the first distribution.

KELLER, PIKE & COMPANY, of Philadelphia, electrical contractors and engineers, have opened an office in Baltimore, at 211 North Calvert Street. This office will be in charge of Mr. John S. Dobler, of Baltimore, whose training, experience and connections especially fit him for this position.

THE DALE COMPANY, New York City, is very busily engaged putting on the market its new Dale wireless cluster, for multiple or series work. It makes up in very compact and handsome form and is cheap and durable. Mr. John Dale is already happy over a rushing business in all the forms of this new specialty.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just placed upon the market two new subscribers-station protectors for the protection of telephones, one consisting of heat coil and carbons and one of heat coils only. They are reported to be very efficient protectors and recommend themselves to the trade on account of merits and low cost.

THE CALCULAGRAPH COMPANY has issued a 16-page pamphlet speaking of the changes in appliances for calculating time. The story begins with the sand glass, talks about the establishment of clocks and their peculiarities, and winds up, of course, with a description of the Calculagraph as a time keeper and a calculator. The catalogue is printed in two colors on a good quality of paper and contains copies of testimonial letters from various users.

TESTING PLATE FOR ENGINES.—One of the most interesting features of the new plant now being erected by the B. F. Sturtevant Company at Hyde Park, Mass., is an elaborate testing plate for its engines. With an output of a thousand engines or more per year, this is the essential climax of a careful system of manufacture and testing. The plate, or more properly the plates, will be supported upon a series of heavy parallel walls between which steam and exhaust pipes are carried so that at almost any point in the entire area of the floor, measuring about 30x60 feet, steam and exhaust connections may be made to any engine. Testing facilities will be provided, and a transfer crane overhead will make it very simple to locate or remove the engines. The same crane will transport them to the packing department, and thence load them directly upon cars which traverse the end of the building.

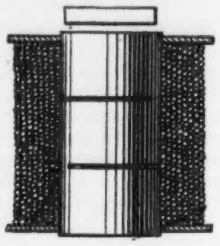
Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 8, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

753,839. TROLLEY WIRE FINDER; William Barnhurst, Dallas, Tex. App. filed June 1, 1903. A pulley pivoted under the trolley wheel and carrying a guiding fork, is rotated by a cord to throw the fork into operative position.

753,866. BRUSH HOLDER FOR ELECTRICAL MACHINES; William H. Foot, Wilkinsburg, Pa. App. filed June 24, 1903. A number of individually actuated brushes of such construction that their position on the rocker arm may be easily and quickly reversed when it is desired to reverse the direction of rotation of the armature.



753,879.—Electromagnet.

753,872. ELECTRIC PRINTING MACHINE; George S. Gallagher, New York, N. Y. App. filed April 29, 1903. Details of construction of a telegraph printer.

753,875. ELECTRICAL MANUFACTURE OF IRON ALLOYS; Gustave Gin, Paris, France. App. filed July 7, 1902. (See page 569.)

753,879. ELECTROMAGNET; Willis D. Gregory, Pittsburg, Pa. App. filed April 9, 1903. The fixed core of the magnet is structurally interrupted in one or more planes transverse to the direction of the magnetic lines, with the object of producing an electromagnet which will quickly discharge itself.

753,881. ELECTRIC SNAP SWITCH; Gerald W. Hart, West Hartford, Conn. App. filed April 18, 1903. Details.

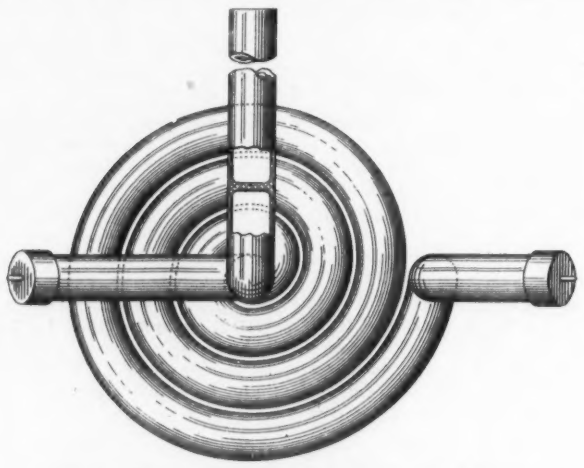
753,916. SHUNT RESISTANCE; Geo. W. Richmond, Pittsburg, Pa. App. filed July 10, 1903. A ribbon resistance set on edge and supported by blocks having slits into which the ribbon fits.

753,935. INCANDESCENT ELECTRIC LAMP; Herbert M. Taylor, Hamilton, Canada. App. filed Sept. 2, 1902. The lamp has an internal conical reflector around which the filament passes, for the purpose of diffusing the light.

753,944. TRANSFORMER CASE; Wm. L. Waters, Milwaukee, Wis. App. filed March 5, 1903. Tubular passages are formed in the casing to permit of a circulation of air for cooling purposes.

753,999. CONTROLLING VALVE; Asa H. Mosher, Westfield, N. J. App. filed Feb. 25, 1903. Details.

754,005. FIRE ALARM OR TEMPERATURE ANNUNCIATOR; John A. Olson, Minneapolis, Minn. App. filed Aug. 3, 1903. An index moving over a dial closes different alarm circuits at different positions on the dial.



754,079.—Spiral Vacuum Tube for Therapeutic Purposes.

754,018. ELECTRIC SAD-IRON; Geo. J. Schneider, Detroit, Mich. App. filed Aug. 11, 1903. The end of the flexible conductor leading to the binding posts of the iron is supported by passing through an opening in the handle just before it reaches the binding post.

754,030. ALARM ATTACHMENT FOR LINOTYPE MACHINES; Geo. L. Venable, New Brunswick, N. J. App. filed April 11, 1903. An electric alarm indicating to the operator when the molten metal in the pot reaches a certain level.

754,075. GAS BURNER; Wm. Kohn, Brooklyn, N. Y. App. filed July 6, 1903. Details.

754,079. SPIRAL VACUUM TUBE FOR THERAPEUTIC PURPOSES; Robert Machlett, New York, N. Y. App. filed Jan. 26, 1904. A flat spiral with the electrode fixed in the outer and inner ends respectively, designed to bring the rays near to the surface of the body and to distribute them over a large surface.

754,081. BATTERY-STOPPER; Albert Muller, New York, N. Y. App. filed Oct. 24, 1903. (See page 569.)

754,111. JUNCTION BOX FOR ELECTRIC WIRES IN BUILDINGS; Boyd W. Allen, Boston, Mass. App. filed Dec. 12, 1903. The bottom of the box is a thick body of insulating material in which the nipple for the fixture is embedded, thus avoiding the use of nails or screws passing behind the box.

754,114. PROCESS OF PREPARING ELECTRODES; George Jones Atkins, Tottenham, England. App. filed Oct. 6, 1903. (See page 569.)

754,123. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Oct. 26, 1903. A metal pin comprising a series of longitudinal webs joined together and forming grooves for a plastic material, to aid in holding the insulator in place.

754,124. ELECTRIC MOTOR; David P. Burdon, Jacksonville, Fla. App. filed July 13, 1903. An oscillating motor having a switch for shifting the current from pole to pole.

754,133. SYSTEM OF ALTERNATING-CURRENT DISTRIBUTION; Edwin R. Gill, New York, N. Y. App. filed Sept. 5, 1900. As a means for producing auxiliary current-waves out of phase with an original single-phase current in a main circuit, an auxiliary circuit having a self-induction approximately equal to that of the main circuit, a condenser and means for alternately charging the condenser from the main circuit during rise of potential in the circuit, and discharging the condenser into the auxiliary circuit, whereby the main and auxiliary circuits are made to carry perodic currents of different phases and common periodicity.

754,147. APPARATUS FOR ELECTRICAL PRODUCTION OF NITROGEN OR OTHER COMPOUNDS; Josef Von Kowalski and Ignaz Moscicki, Freiburg, Switzerland. (See page 569.)

754,152. SIGNALING APPARATUS; Otto Luddeckens, Breslau, Germany. App. filed Feb. 21, 1903. A signal for mines in which the engine room receives the signals passing between the pit bottom and the mouth and the engineer is able to prepare in advance for signals coming direct to him from the mouth of the mine.

754,208. ELECTRIC SIGNAL; Joseph E. Feller, Brooklyn, N. Y. App. filed April 24, 1902. Relates to the construction of instruments in which the person signalled may indicate to the person signalling if the signal is properly received.

754,235. EXTENSION FIXTURE FOR INCANDESCENT ELECTRIC LAMPS; Conrad H. Titel, Meriden, Conn. App. filed May 6, 1903. A spring drum and ratchet arrangement for taking up and letting out the conductor and the mechanical support for the fixture.

754,261. OZONIZER; Alexander Vosmaer, Nieuwersluis, Amsterdam, and Adriaan Lebret, Utrecht, Netherlands. App. filed Sept. 11, 1902. (See page 569.)

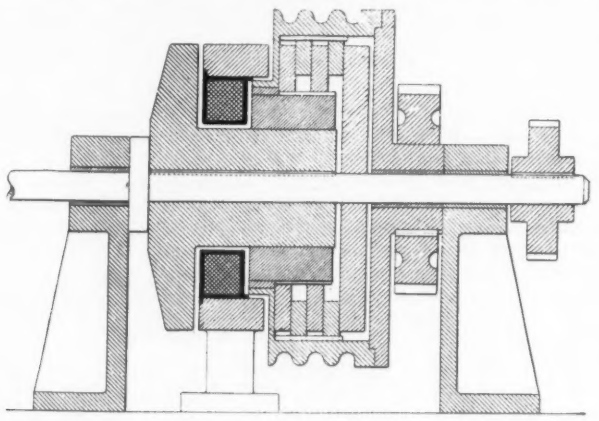
754,291. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, O. App. filed Jan. 26, 1904. Interleaved metal plates are caused to frictionally engage by a magnet placed to act upon them.

754,294. HORSE BLANKET; Ida J. Foglesong, St. Paul, Minn. App. filed Sept. 17, 1903. Electric heating wires are threaded through the blanket for the purpose of sweating the animal.

754,359. APPARATUS FOR STOPPING RAILWAY TRAINS FROM THE LINE AND FOR SIGNALING PURPOSES; Bernardus A. J. Van Der Hegge-Zijnen, Hanover, Germany. App. filed May 26, 1902. An arm is projected from the roadway to strike an air-brake valve of the train to set the brakes. The contact between the parts closes a circuit to notify an operator at a station of the event.

754,362. RAILWAY SIGNALING SYSTEM; Henry Bezer, Westfield, N. J. App. filed Oct. 16, 1901. Various features of a block system in which the rails of the track are the only conductors from one end of the block to another.

754,363. RAILWAY SIGNALING SYSTEM; Henry Bezer, Westfield, N. J. App. filed Oct. 16, 1901. A modification of the preceding patent.



754,291.—Magnetic Clutch.

754,378. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed June 27, 1903. Improved devices for transmitting movement from the spindle to the catch which holds the spring until it has been fully put under tension.

754,379. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed Oct. 6, 1903. Details.

754,380. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed Oct. 6, 1903. Details.

754,391. BURGLAR ALARM; Freeman C. Robinson and James E. Green, Council Bluffs, Iowa. App. filed Nov. 26, 1901. A pair of contacts are attached to the bolt of a safe and while the bolt is in its locked position, rest upon a plate of insulating material, but as soon as the bolt is withdrawn, they drop onto a metal surface, closing an alarm circuit.

754,397. ELECTRIC CLOCK; Geo. S. Tiffany, Brooklyn, N. Y. App. filed Nov. 30, 1901. Details.

754,402. FAULT LOCATOR FOR ELECTRIC CABLES; Daniel E. Wiseman, Spokane, Wash. App. filed Aug. 3, 1903. A Wheatstone bridge in which the scale of resistance is read directly in units of length.

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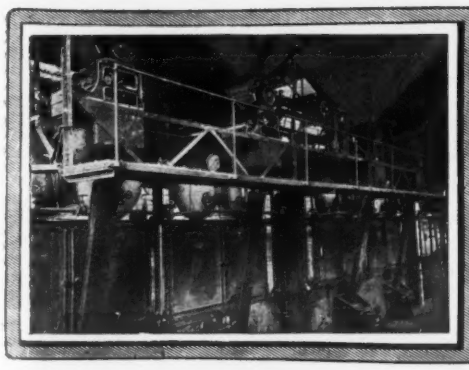

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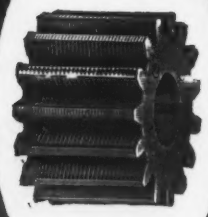
OF ELECTRICAL WORLD AND ENGINEER HAVE A FULL KNOWLEDGE OF EVERYTHING YOU MAKE?
They may never have known, or they may have known years ago.
They may still have a partial knowledge; but unless you
ADVERTISE PERSISTENTLY
it does not take very long to be forgotten.



Stop That Noise!
New Process Pinions will do it. There is no ring to rawhide, so they can't make the racket that metal gears do. And New Process rawhide wears like iron. Get our booklet.
The New Process Raw Hide Company,
SYRACUSE, N. Y.

POSITIONS WANTED.

The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

POSITION WANTED.—By a really first-class engineer and superintendent of electrical properties; A-1 references and ability; parties desiring a capable man with wide experience and executive ability should reply. Address No. 1346, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent; fourteen years' practical experience installing and operating light and power plants, water power and steam. Address No. 1282, care Electrical World and Engineer, New York.

POSITION WANTED.—By manager of railway and lighting system; engaged in present situation four years; desires change as manager or general superintendent; fourteen years' practical engineering and business experience; for details and references, address No. 1362, care Electrical World and Engineer, New York.

POSITION WANTED.—Engineer, thoroughly experienced in all branches of construction work and repairs, particularly as applied to electric railways, desires position; power station erection and equipment a specialty; accustomed to take charge of work; eleven years' experience in America and abroad. Address No. 1364, care Electrical World and Engineer, New York.

POSITION WANTED.—As foreman in meter department of lighting company by a technical graduate with four years' factory experience in testing, inspecting T. H. Westinghouse watt-hour meters, G. E. and Sprague motors and generators; A-1 record with above companies. Address No. 1361, care Electrical World and Engineer, New York.

POSITION WANTED.—About July 1 in construction work or as estimator by an American, 31 years old; has technical education and is an experienced draughtsman, both mechanical and electrical; also has experience in testing and switchboard design and erection with one of the largest electrical manufacturing companies. Address No. 1371, care Electrical World and Engineer, New York.

WANTED

YOU, who are troubled with sparking and cutting of commutators, to use

It will put that high gloss on the commutator you have so long sought.

For Sale by all Supply Houses.

SAMPLE STICK SENT FREE

The only article that will PREVENT SPARKING. Will keep the commutator in good conditon and PREVENT CUTTING.

ABSOLUTELY WILL NOT GUM THE BRUSHES . .

K. McLENNAN & CO.

Sole Manufacturers (3)

100 WASHINGTON ST. **CHICAGO, ILL.**

WHY DON'T YOU —— Put a Little

Hare's Commutator Compound

on that Sparking Motor, and save the Commutator? Save your time too. Both cost money.

Big Stick, 35c. Enough to show you FREE.

SOUTHWORTH & HARE, Indianapolis, Indiana

IF YOU WANT AN ARTICLE THAT WILL REPEAT ITSELF.

TRY **U. S. METAL POLISH**

FOR POLISHING ALL KINDS OF METALS.

Sold by Dealers. Samples Free.

Geo. W. Hoffman, MANUFACTURER. 295 E. Washington St., Indianapolis, Ind.

MECHANICAL DRAWING AND DESIGN

$3 Postpaid

Rogers' Drawing and Design gives a thorough and comprehensive self-instruction course in the principles and practice of Drawing and Designing required in the shops and drafting rooms of the engineering, electrical, machinery and kindred trades.

506 pages, 610 illustrations. Clearly printed on superfine paper and handsomely bound in black vellum cloth, with full gold edges. *The money paid will be refunded if the book is not found to be satisfactory.*

THEO. AUDEL & CO., Educational Book Publishers, 63 Fifth Ave., New York

Specimen pages and a complete list of contents sent postfree upon request

POSITION WANTED.—Electric Light Manager now occupying responsible position in large western city would consider similar opening in eastern United States or Canada. Address No. 1345, care Electrical World and Engineer, New York.

POSITION WANTED.—By Cornell graduate Electrical Engineering with experience in the testing department of the General Electric Company; age 31; long business experience; commanding languages; fully qualified for position of salesman for steam and electric apparatus; will offer services for a reasonable amount. Address No. 1368, care Electrical World and Engineer, New York.

POSITION WANTED.—As manager or superintendent of lighting or railroad company, or would take charge of testing department of large concern; have had eight years' experience in the lighting and power field and am at present in charge of a department of one of the largest manufacturing concerns; age 28, good executive and economist; moderate salary to start. Address No. 1367, care Electrical World and Engineer, New York.

POSITION WANTED.—Engineer, college graduate in Electrical and Mechanical Engineering, 5 years' practical experience machine shops and drawing office; 12 years' experience in the operation of electric light and power and mill plants at home and abroad; wishes position as superintendent or assistant; age 38; disengaged March 31. Address No. 1374, care Electrical World and Engineer, New York.

POSITION WANTED.—By graduate of first class technical school; two years' practical experience in testing and experimental work; familiar with high and low tension work, testing instruments, etc.; excellent draughtsman and mechanic. Address No. 1373, care Electrical World and Engineer, New York.

POSITION WANTED.—By American young man, 20; good personality, mechanical inclination, A-1 habits and home surroundings with parents; selects electrical business with future as life's calling; solicits trial situation on his merits with large contracting concern or others; security, endorsement. Address No. 1375, care Electrical World and Engineer, New York.

(Continued on page 49.)

ALTERNATORS—60 CYCLES.

1100 or 2200 Volts.

Lt.		
2	300	Gen. Elec., 15-K.W., comp., single phase.
1	500	Wood, 25-K.W., comp., single phase
1	600	West., 30-K.W., comp., single phase
1	750	Wood, 37½-K.W., comp., single phase
1	900	West., 45-K.W., comp., 2 phase.
1	1200	West., 60-K.W., single ph., comp.
1	1500	Warren-Medberry, 75-K.W., 2 ph., ind. type
1	1500	Stan., inductor, 75-K.W., 2 ph.
1	1500	West, 75-K.W., comp., distributed winding, 2 ph.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine
1	1500	Wood, 75-K.W., comp.
1	2400	Gen. Elec., 120-K.W., 3 phase, 2200 or 3300 v.
1	7200	Gen. Elec., 360-K.W., 3 phase, 2300 volts
1	3000	Westinghouse, single phase, 150-K.W., 2200 volts, latest type, direct connected to 12x24x14 Harrisburg tandem compound self-oiling engine, complete with exciter and switchboard panel, speed 257

ALTERNATORS—125-133 CYCLES.

Lt.		
1	650	Wood, 33-K.W., comp.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W., comp.
1	900	Warren-Medberry, 45-K.W., inductor type
1	1000	Wood, 50-K.W., comp.
2	1200	West., 60-K.W., toothed armt., comp.
1	1500	Wood, 75-K.W., comp.
1	1500	Stanley, inductor type, 75-K.W., 1100 or 2200 v., 2 phase.
1	2400	Gen. Elec., 120-K.W., type A 120, latest type, comp., toothed armt.
2	2400	Gen. Elec., 120-K.W., type A S, comp., slotted armt.
2	2400	West., 120-K.W., comp., self-oiler, toothed armt.
2	3000	Stanley inductor type, 150-K.W., 1100 or 2200 v., 2 phase.
1	8000	West., 400-K.W., slotted armt., 3 bearings, distributed windings

110 TO 125 VOLT GENERATORS.

DIRECT CURRENT.

Lt.			Speed.
6	10	Towle, M. P., compound	2000
2	12	Edison, self-oiler	2700

LATEST TYPES OF (second-hand) ELECTRICAL MACHINERY

FOR SALE AT BARGAIN PRICES

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing complete list of apparatus with NET PRICES. All machines fully guaranteed.

Lt.			Speed.
1	15	Wagner, 15 amp., M.P. 50 v.	1800
1	30	General Electric, type C A	2100
2	35	Hobart, M. P., comp.	1600
1	40	Roth, M. P., comp., direct connected to Drake engine	800
1	45	Lundell	1800
3	45	Westinghouse, M. P., comp	1800
1	50	Crocker-Wheeler, self-oiler	1150
2	50	Northern, M. P., compound	2050
1	50	Westinghouse, M. P., comp.	1150
2	60	Hobart, M. P., comp., s-o.	1200
1	75	Westinghouse, M. P., comp.	1600
1	75	Phoenix, comp., direct connected to No. 4 Case engine	650
1	80	Fort Wayne, multipolar	1600
1	80	Crocker-Wheeler	1000
1	80	Riker, M. P., comp., s-o.	1100
1	80	Perrett, multipolar	950
1	100	Triumph, M. P., comp.	1250
1	100	Card, M. P.	1000
2	110	Commercial, M. P., comp.	1600
1	150	Edison, comp.	1700
1	150	Eddy, M. P.	1650
1	150	Western Elec., M. P.	1600
1	150	General Electric, M. P.	1400
1	160	Triumph, M. P., compound	1200
1	160	Northern, M. P., compound	900
1	165	Am. Engine Co., M. P.	1400
1	210	Edison, self-oiler, 12-K.W.	1600
1	210	Phoenix, M. P., comp.	1650
1	210	Eddy, M. P.	1100
1	225	Card, M. P., comp.	690
1	260	Commercial, M. P., comp.	1100
1	300	Phoenix, M. P.	1100
1	300	Perrett, M. P., comp.	750
1	300	Ahlms-Edwards, M. P., comp.	825
2	300	Gen. Electric, M. P., comp.	1100
1	300	Western Elec., M. P., comp.	750
2	350	Edison, 20-K.W., comp., s-o.	1400
2	350	C. & C., M. P.	800
1	350	Card, M. P., enclosed	800
1	400	Northern, 22½-K.W., M. P., comp.	1000

Lt.			Speed.
1	400	Crocker-Wheeler, M.P., comp.	875
2	400	Westinghouse, M. P., comp.	975
2	450	Edison, 25-K.W., self-oiler	1300
2	450	Commercial, M. P., comp.	1000
1	450	Quaker City, M. P., comp.	1000
1	450	Triumph, M. P., comp.	750
2	450	Sprague-Lundell, M. P., comp	875
1	450	Eddy, M. P., comp.	950
Lt.			Speed.
1	450	Gen. Electric, M. P., comp.	1050
1	450	Western Elec., M. P., comp.	650
1	540	Edison, comp., 30-K.W.	1200
1	540	C. & C., M. P., 30-K.W.	700
1	540	Elwell-Parker, M. P., comp.	600
2	540	Gen. Elec., M. P., comp. 30-K.W.	1000
3	600	Card, M. P., compound	750
1	650	Milwaukee, M. P., comp.	650
1	650	Westinghouse, M. P., comp.	900
1	650	Westinghouse, M. P., 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine, class A, upright	350
2	700	Commercial, M. P., comp.	865
1	700	Card, M. P., compound	750
1	700	Crocker-Wheeler, M. P., comp.	1085
1	900	Wagner, M. P., comp., 50-K.W.	950
1	1000	Edison, s-o., 60-K.W., comp.	700
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.	275
1	1100	Triumph, M. P., comp., 65-K.W.	850
1	1300	Card, M. P., comp., 75-K.W.	500
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine	265
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.	275

Lt.			Speed.
1	1300	Gen. Elec., M. P., 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine	270
2	1800	Edison, 100-K.W., s-o., comp.	650
1	1800	Western Electric, M. P., comp., 6 pole, 100-K.W.	425
1	2200	Western Electric, M. P., 125-K.W., latest type, comp., 6 pole, 3 bearing. (Above machine can be arranged for direct connection also.)	225
2	2500	Western Electric, M. P., comp., 150-K.W., direct connected to 16x18 McEwen engine	240

220 TO 250 VOLT GENERATORS.

K.W.		Speed.
7½	Holtzer-Cabot, compound	1350
9	New England, M. P.	1600
10	T.-H., D 10, oil cups	1600
12	Western Elec., M. P., comp.	750
15	Edison, self-oiler	1500
17½	Kester, comp.	1350
17½	Eddy, type C, comp.	1450
20	Edison, self-oiler, comp.	1400
20	Western Electric, comp., s-o.	700
20	Keystone, M. P., comp.	950
20	Eddy, M. P., comp.	825
20	Western Elec., M. P., comp.	650
30	C. & C., comp., self-oilers	800
40	E. & C., multipolar, comp.	750
40	Eddy, M. P., comp.	875
40	Commercial, M. P., d. c. to 11x12 automatic Chandler-Taylor engine	300
45	Edison, comp., self-oiler	1000
45	Am. Engine Co., M. P., comp.	700
45	Western Elec., M. P., comp.	550
45	C. & C., M. P., comp.	700
45	Gen. Elec., M. P., comp.	925
50	C. & C., compound	800
50	Commercial, M. P., comp.	775
50	Maine, M. P., compound	600
55	Fuller, multipolar, comp.	750
55	Eddy, M. P., comp.	750
60	Sprague, compound	500
60	Northern, M. P., comp.	800
75	Siemens & Halske, Churchward type, M. P., direct connected to 14x14 Ideal engine	300
80	C. & C., comp., self-oiler	625
100	Edison, comp., self-oiler	650
100	Commercial, M. P., comp.	675
125	Eddy, M. P., comp.	700
150	National, M. P., comp.	350
200	Eddy, multipolar, compound	500
250	Western Electric, 6 pole, type L, 3 bearing, compound	450
300	Western Electric, M. P., brand new	480

DYNAMOS ✿ MONEY SAVERS ✿ ENGINES

500 VOLT GENERATORS AND MOTORS

2—500-K.W. Westinghouse, 4 pole.
2—300-K.W. General Electric, 4 pole.
1—300-K.W. Westinghouse, 6 pole.
1—200-K.W. General Electric, 4 pole.
1—200-K.W. Edison bipolar.
2—175-K.W. Edison bipolar.
1—150-K.W. Westinghouse, 4 pole.
1—110-K.W. General Electric, 6 pole.
2—100-K.W. General Electric, 4 pole.
2—100-K.W. Edison bipolar.
1— 75-KW. Westinghouse, 6 pole.
4— 75-K.W. General Electric, 4 pole.
3—D-62-K.W. T. H. bipolar.
Complete stock of motors.

220 VOLT GENERATORS AND MOTORS

1—120-K.W. C. & C., 6 pole.
1—100-K.W. C. & C., 6 pole.
1— 50-K.W. Bullock, 4 pole.
1— 40-K.W. Crocker-Wheeler, 4 pole.
1— 16-K.W. Ft. Wayne, 4 pole.
1— 12-K.W. Keystone, 4 pole.
Complete stock of motors.

110-125 VOLT GENERATORS AND MOTORS

2—45-K.W. Westinghouse, 4 pole.
2—60-K.W. Edison bipolar.
1—40-K.W. C. & C., 4 pole.
1—35-K.W. Loomis, 6 pole.
1—35-K.W. Mather, 4 pole.
1—21-K.W. Riker, 4 pole.
1—17½-K.W. General Electric, 4 pole.
1—15-K.W. Edison bipolar.
1—12½-K.W. Card, 4 pole.
2—3-K.W. Westinghouse bipolar.
Complete stock of motors.

DIRECT CONNECTED UNITS

200-K.W. Thomson-Ryan, 125 volts, D. C. McEwen Tandem Engine.
80-K.W. Jenney, 125 volt, D. C. Russell 4-valve engine.
50-K.W. Northern, 125 volt, D. C. Russell (new).
2—50-K.W. American Ball, 220 volts, D. C. duplex and simple engines.
2—42-K.W. Westinghouse D. C. Alfrey engines.
30-K.W. Eddy, 125 volts. D. C. Watertown engine.
25-K.W. Westinghouse, 125 volt, D. C. Westinghouse.
7½-K.W. Northern, 125 volt, D. C. Hill Vertical Engine (new).
6-K.W. ditto.
4-K.W. ditto.
3-K.W. ditto.

ALTERNATING (60 Cycle

250-K.W. Westinghouse, 60 cy., 2 ph., 2,200 volts.
100-K.W. G. E., 60 cy., 3 ph., 2,300 v.
65-K.W. Stanley, 60 cy., 2 ph.
20-H.P. Westinghouse, 2 ph., 60 cy.
3-H.P. Westinghouse, 2 ph., 60 cy.
2-H.P. G. E., 3 ph., 60 cycle.

ALTERNATING (125 Cycle)

120-K.W. G. E., s. ph., 1,100 v.
120-K.W. Westinghouse, 2,200 v.
100-K.W. G. E., s. ph., monocyclic.
2—A-70 T. H., s. ph., 1,100 v.
1—60-K.W G. E., s. ph., 1,100 v.
2—35-K.W. Westinghouse, 1,100 v.
10-H.P. Excelsior, s. ph., 125 cycle.

ENGINES

3—11 and 17x24 Harrisburg tandem.
1—16 and 30x48 Hamilton Corliss.
1—17x42 Brown of Fitchburg.
1—14x28 Delamater Corliss.
1—13x21 Buckeye tangye bed (130 H.P.).
1—13x14 McIntosh & Seymour.
2—13x12 Erie Ball automatic (with subbases).
2—9½x10½ McIntosh & Seymour.
1—8x8 Climax automatic.

Boilers **THOMPSON SON & CO., 114 LIBERTY ST., N. Y.** Equipments

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNIT, 220 volts

50-K.W. American Ball Dynamo & Engine.

10 VOLTS DIRECT CURRENT
Dynamos or Motors

30-K.W. Bullock, M. P.
15-K.W. Eddy, M. P.
10-K.W. Eddy, M. P.
5-K.W. C. & C.
3-K.W. C. & C.
2-K.W. Lundell.
1-K.W. C. & C.

500 VOLTS DIRECT CURRENT
Dynamos or Motors

15-H.P. General Elec., M. P.
7½-H.P. General Elec., M. P.
5-H.P. Sprague.
2-H.P. General Elec.

220 VOLTS DIRECT DURRENT
Dynamos or Motors

40-H.P. Sprague, M. P.
25-H.P. Crocker-Wheeler, M. P.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. General Elec.
10-H.P. Holtzer Cabot.
7½-H.P. Card.
7½-H.P. Edison.
7½-H.P. C. & C.
5-H.P. Paragon, M. P.
5-H.P. Holtzer Cabot.
5-H.P. Crocker-Wheeler.
3-H.P. Diehl.
3-H.P. C. & C.
2-H.P. General Elec.
2-H.P. Diehl.
1½-H.P. C. & C.
1-H.P. Crocker-Wheeler.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.
¼-H.P. General Elec.

2 Phase, 440 Volts, 60 Cycles

30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
5-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Elec., 220 volts.
½-H.P. General Elec., 110 volts.

1 Phase, 60 Cycles

7-H.P. Wagner, latest type.
½-H.P. General Elec.
¼-H.P. General Elec.

1 Phase, 125 Cycles

3-H.P. Wagner, latest type.
1-H.P. General Elec.
½-H.P. Emerson.
1/10-H.P. Emerson.
Large stock of small motors, autostarters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

I BUY, RENT AND INSTALL.—GEORGE BENDER, 137 CENTRE STREET, NEW YORK.

ELECTRIC LOCOMOTIVES.

	Ton.		
1	10	Morgan-Gardner, type M, 250 v., direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour	
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour	

500 TO 550 VOLT GENERATORS.

	K.W.		Speed.
1	60	Edison, comp., self-oiler, new armt. and commutator	800
1	62	T.-H., D 62, s-o., comp.	900
1	75	Akron, M. P., 6 pole	900
1	75	Bullock, multipolar	900
2	75	General Electric, M. P. 4, comp., new rewound	700
1	100	Siemens & Halske, 4 pole, with bar-wound armature, compound	600
2	100	Edison, compound	650
1	100	Gen. Elec., M. P. 4, comp.	650
1		General Electric slate panel switchboard for above, complete with ammeter, circuit breaker and resetting device, main line switch, rheostat switch, bus-bar connections, etc.	
2	120	Westinghouse, M. P., comp.	625
1	200	Thompson-Ryan, M. P., comp., three bearings	525
1	200	General Electric, M. P. 4, comp., s-o., 3 bearings, new commutator	400

ARC DYNAMOS.

	Lt.	C.P.		Speed.
1	35	2000	T.-H., L D 2 ball	820
1	45	1200	Brush, No. 7	1050
1	50	1200	T.-H., L D 12, new ball	820
2	50	2000	T.-H., M. D 2, s-o., ring	820
1	65	2000	Brush, No. 8	950
1	75	1200	T.-H., M D 12, s-o.,	820
1	75	1200	Wood	950
1	100	2000	Wood	600
1	125	1200	Brush, 6.6 amp.	700
2	125	2000	Brush, 9.6 amp.	500
1	125	1200	Excelsior	700

ATTENTION, MANUFACTURERS.

Extra Slow Speed Motors, 220 volts, direct-current, suitable for operating drills, lathes, presses and tools of all descriptions electrically.

	H.P.		Speed.
1	½	Maine, M. P.	450
1	¾	Maine, M. P.	400
4	¾	Maine, M. P.	260

BARGAINS IN
(second-hand) ELECTRICAL MACHINERY

We do not offer old, worn out machines fit for the Junk pile, but the LATEST TYPES of the leading manufacturers.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed.

	H.P.		Speed.
1	1	Maine, M. P.	500
1	1	Maine, M. P.	450
1	1½	Maine, M. P.	500
4	2	Maine, M. P.	260
1	3	Storey, variable speed	300-1500
1	3	eystone, compound	650
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
5	5	Western Electric, M. P.	950
1	5	Eddy, M. P.	300
3	5	Belknap, M. P.	230
1	6½	Jenny, M. P., back geared, speed of shaft	440
1	7½	Milwaukee, M. P., series, crane type, grease cup	600
1	8	Crocker-Wheeler, series, crane type	900
1	8	Maine, M. P.	200
1	10	Bernard, M. P.	170
3	10	Bernard, M. P.	130

All machines fully guaranteed.

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.	Speed.
1	1	General Electric, type I B	1025
1	1⅛	Commercial, self-oiler	1200
1	2	Lundell, newly rewound	1000
1	2½	Riker, s-o., with extra armt.	1460
1	3	C. & C.	1400
1	3	Bernard, M. P.	1525
1	3	Gibbs, M. P.	1400
1	3	Lundell, self-oiler	1500
3	3	Western Electric, M. P.	1000
3	3	Westinghouse, M. P.	1700
1	3	Storey, variable speed	300-1500
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
2	5	Gibbs, M. P.	1400
3	5	Hobart, M. P.	1050
5	5	Western Electric, M. P.	950
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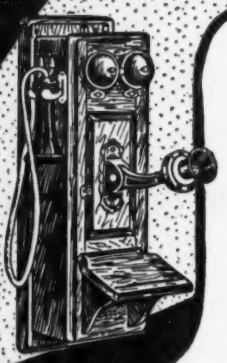

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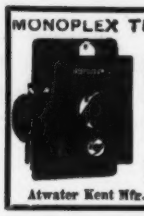

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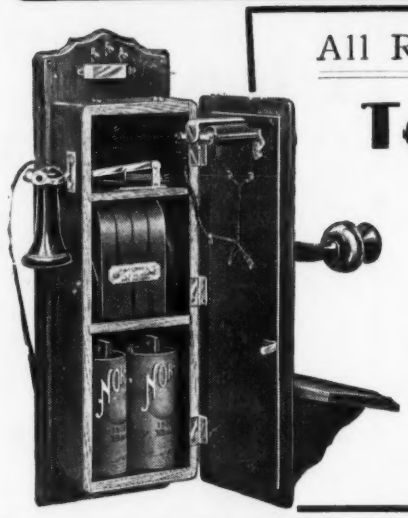

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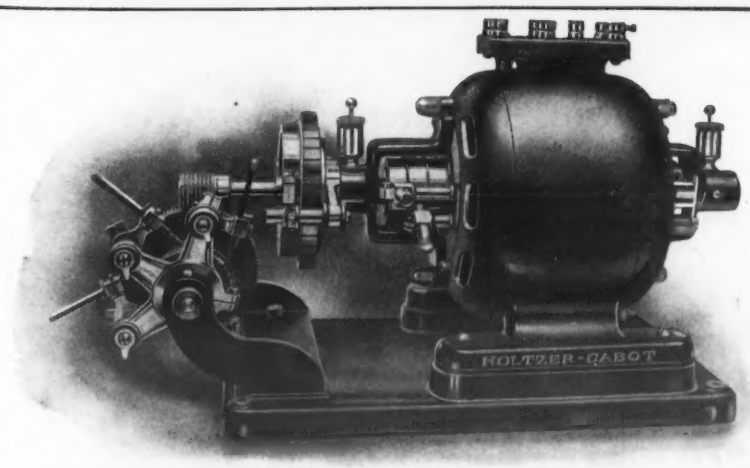

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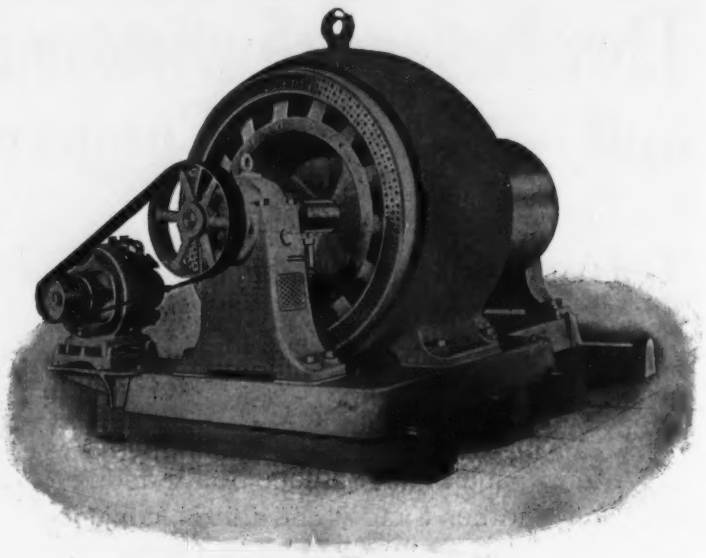

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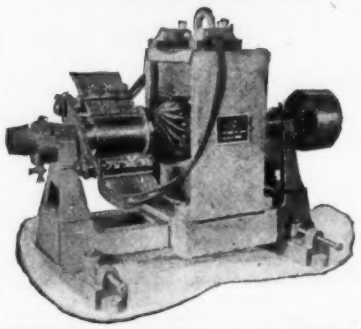

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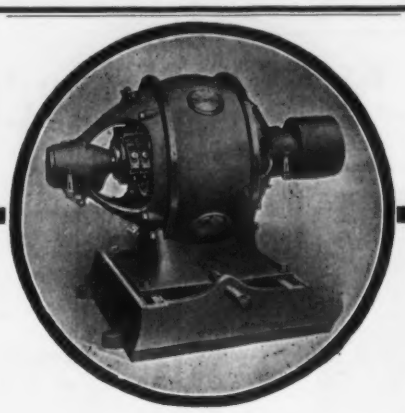

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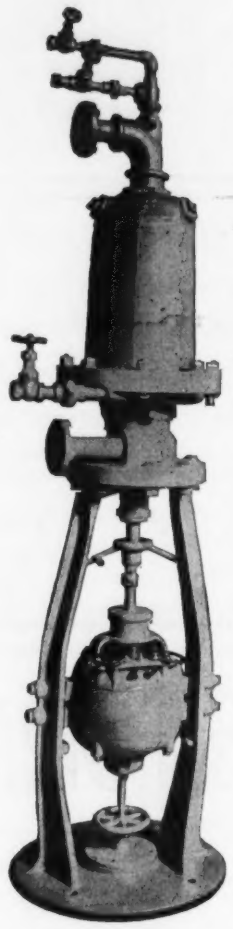

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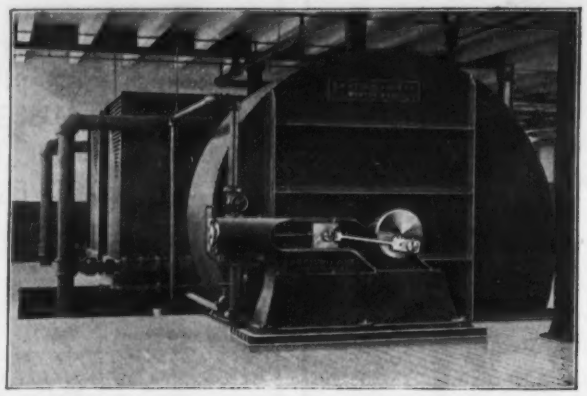

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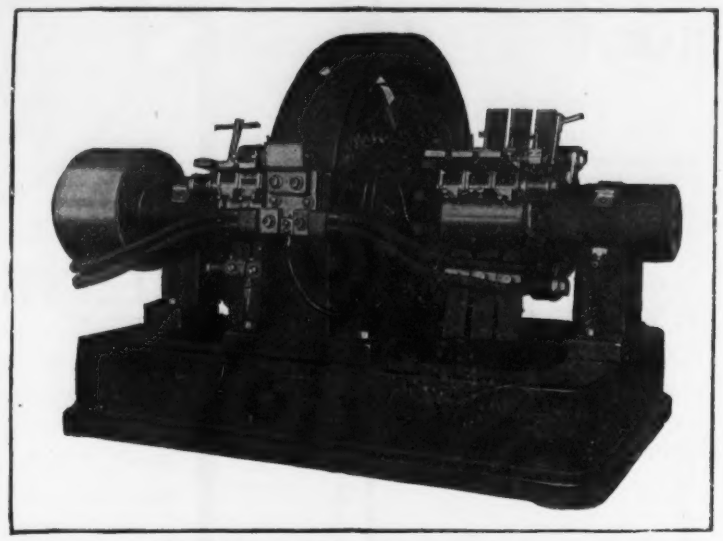

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